9.3.9 CHEMICAL SPILL NO. 10 (CS-10) GROUND WATER

A BACKGROUND

A.1 Site Description

The CS-10 groundwater plume is located at the southeast corner of the MMR, as shown in **Figure 9.3.9-1**. The plume consists of primarily of TCE and PCE, but other contaminants (i.e., EDB) are present at lower concentrations. CS-10 groundwater contamination is a result of a number of potential sources; however the main contributor is the Boeing Michigan Aerospace Center (BOMARC) / Unit Training Equipment Site (UTES).

Currently, the CS-10 plume is divided into five parts based on cleanup systems that have been installed, and the plume cleanup decision to be made. There are five components of the CS-10 groundwater contamination: (1) the Sandwich Road lobe (2) the in-plume area (3) southwestern lobe (4) southern lobe (5) and the leading edge which is composed of four lobes: the northern lobe (formerly known as the TCE plume); north-central lobe; south-central lobe; and southern lobe. Please note that the CS-10 plume was one of the seven plumes in the IROD, and is currently undergoing the process (i.e., RI/FS/Proposed Plan/ROD) to reach a final decision for the entire plume including the leading edge.

A.2 Initial Responses

CERCLA Actions:

CS-10 Source Area Remedial Action:

AFCEE is excavating contaminated soil from the CS-10 source area. In addition, AFCEE is currently performing AS/SVE to remove chlorinated VOCs from the unsaturated zone. Refer to Section 9.3.8 for the status of CS-10 Source Area.

Mashpee Private Well Moratorium:

The Mashpee Board of Health adopted a moratorium on groundwater wells which states that existing and future residential wells located in documented or anticipated areas of groundwater contamination as defined by the Board of Health are restricted from use for any purpose (AFCEE 2002a).

Residential Well Sampling Program:

AFCEE has implemented an annual residential sampling program in which AFCEE tests residential wells potentially impacted by plumes for VOCs and/or EDB. In some cases, homes are tested more frequently. For areas where AFCEE has deemed private well water is imminently threatened, bottled water is supplied.

Workers and residents at MMR are connected to a public water supply. Residents of Mashpee also have been connected to public water supply. AFCEE has offered free town water hookups to residents of towns surrounding the base in which their private well water was threatened, or potentially threatened by chemicals from the base.

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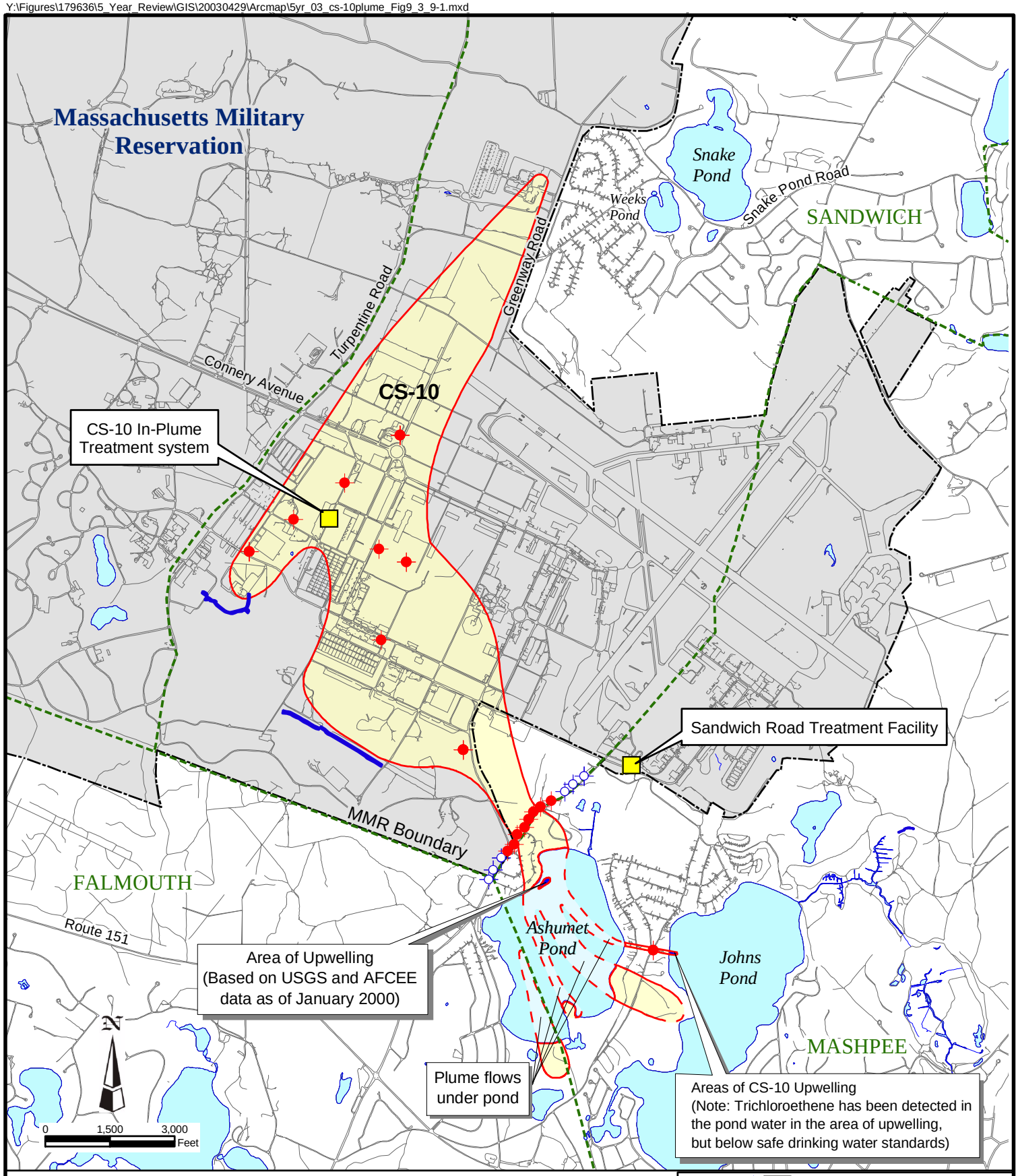

Legend

Plume Contour = Concentrations exceeding drinking water standards or Maximum Contaminant Level (MCL). Represents an exceedance of trichloroethene (TCE) and/or perchloroethene (PCE).
(TCE MCL = 5 µg/L)
(PCE MCL = 5 µg/L)

- Treatment Facility
- Town Boundary
- Infiltration Trenches
- Treatment System Piping
- Upwelling
- Extraction Well
- Reinjection Well

Air Force Center for Environmental Excellence

Chemical Spill-10 (CS-10) Plume
December 2002

Massachusetts Military Reservation
Cape Cod, Massachusetts

Figure 9.3.9-1

Time-Critical Removal Action (for Northern Lobe):
One extraction well was installed in January 2000 to extract TCE-contaminated groundwater before it discharged to Johns Pond. Extracted water was piped to the Sandwich Road Treatment Facility (SRTF).

Non-CERCLA Actions:

Several non-CERCLA source removal activities occurred at the CS-10 source area in 1996. At the CS-10 source areas, fifteen drainage structures were removed as part of the DSRP. For more information regarding CS-10 source area, refer to Section 9.3.8.

A.3 Basis for Taking Action

The basis for taking action is results of two risk assessments conducted for the CS-10 groundwater contamination (CDM, 1996) and (AFCEE, 2001b). Future residential exposure to contaminated groundwater present an excess lifetime cancer risk greater than the acceptable MADEP threshold of 1×10^{-5} and the acceptable USEPA range of $1\text{-}10^{-4}$ to $1\text{x } 10^{-6}$. Please note that the CS-10 Plume is one of the seven plumes addressed in the Record of Decision for Interim Action (known as the IROD). Final selection of COCs will be presented in the Final ROD. Table A-1 presents Interim Action COCs. Ecological risk assessments indicate that discharge of plumes to surface waters do not pose a threat to ecological receptors.

PCE	Human Health	5	Fed MCL
TCE	Human Health	5	Fed MCL

B REMEDIAL ACTIONS

This section presents the regulatory actions, RAOs, and remedy descriptions for the CS-10 plumes.

B.1 Regulatory Actions

1994: A Plume Response Plan was developed to contain seven groundwater plumes simultaneously. The Plume Management Process Action Team helped coordinate development of this plan. The Plume Response Plan was used as a substitute for the Feasibility Study and as a basis to develop the Proposed Plan. The NGB, DoD, USEPA, MADEP, and local communities approved the plan, resulting in an accelerated effort toward "simultaneous containment" of the following seven groundwater plumes: Ashumet Valley, CS-10, Eastern Briarwood, FS-12, LF-1, SD-5, and Western Aquafarm.

1995: The NGB and USEPA, with MADEP concurrence, signed a Record of Decision for Interim Action (known as the IROD) (ANG, 1995) for seven groundwater plumes identified at the MMR. The IROD enabled the NGB to take immediate action to protect human health and the environment, while collecting additional information to evaluate and select final cleanup alternatives.

1996: The NGB issued a 60% design report for plume containment. While the 60% design protected human health, it presented significant ecological impacts to the environment. AFCEE was brought in to manage the IRP. The Technical Review and Evaluation Team (TRET), consisting of various technical experts, were established as an independent review committee to provide advice and recommendations. After reviewing the 60% design document, the TRET developed recommendations for next steps for each plume. Based on the TRET recommendations, AFCEE was to build treatment systems for CS-10.

1997: In response to the technical deficiencies of the 60% design for simultaneous containment of the IROD plumes, AFCEE, USEPA and MADEP introduced the DCM process, an accelerated decision-making tool to refine cleanup decisions. The DCM process was applied to the CS-10 groundwater plume. The DCM gave the public an opportunity to review alternatives and make suggestions for final cleanup measures prior to the remedy selection. In December 1997, the *CS-10 Plume Response Decision Fact Sheet* (AFCEE, 1997) was issued to document the decision to implement the remedy.

The CS-10 plume is currently undergoing the process to reach a final ROD which will include a decision for the leading edge of the plume.

B.2 Remedial Action Objectives

The objectives were defined in the IROD were used as the basis for determining cleanup goals.

The objectives in the IROD are described as follows:

- reduce the risks to human health associated with the potential future consumption and direct contact with groundwater and surface waters;
- protect uncontaminated groundwater and surface waters for future use by minimizing the migration of contaminants;
- reduce potential ecological risks to surface waters and through the implementation of the containment system; and,
- restore the aquifer (within confines of the CS-10 plume) to its beneficial uses within a 20 year timeframe.

B.3 Remedy Description

As a result of the DCM process, multiple systems were selected for cleanup of the CS-10 plume. The CS-10 groundwater plumes are being remediated by the CS-10 In-Plume ETI treatment system and CS-10 Sandwich Road ETR system. Descriptions for these systems are provided below. Please note that these systems have been modified and are discussed in section B.4.

<u>CS-10 Sandwich Road ETR System:</u>

The CS-10 Sandwich Road ETR system initial design consisted of eight extraction wells, GAC, and six reinjection wells. The extracted groundwater is processed through the SRTF. At the SRTF, the extracted groundwater is filtered and treated using GAC filters to remove contaminants, including chlorinated VOCs and EDB. After treatment, the water is returned to the ground through a series of six reinjection wells situated downgradient of the extraction wells along the MMR boundary.

CS-10 In-Plume ETI System:

The CS-10 In-Plume ETI system initial design consisted of five extraction wells, two modular treatment buildings (each with one GAC train) and two infiltration trenches. The infiltration trenches were designed to place water back into the aquifer near ground surface. Three additional extraction wells which were initially referred to as the Southwest/Southern (SW/S) system was added to the CS-10 In-Plume system.

B.4 Remedy Implementation

Described below are interim remedies that address the CS-10 groundwater contamination as documented in the *CS-10 Plume Response Decision Fact Sheet* (AFCEE, 1997). AFCEE is in the process of completing a final ROD. Current site characterization, interim remedy performance, and risk assessment results will be evaluated to identify an appropriate remedy.

Two groundwater systems were constructed to address CS-10 groundwater contamination. They include the following:

Groundwater Treatment Systems:

- CS-10 Sandwich Road ETR System: The CS-10 Sandwich Road ETR system startup date was May 18, 1999. The objective of this system is to contain contamination at Sandwich Road. The system extracts groundwater from eight EWs, which is then treated using GAC filters to remove contaminants, including chlorinated VOCs. After treatment, the water is returned to the aquifer through a series of six reinjection wells. The ETR system has removed approximately 225 kg of contaminants since startup through December 2001 (AFCEE, 2002a). In May 2001, one extraction well, (03EW2170) was shut down because it was not extracting contamination (plume collapsed eastward) (AFCEE, 2002b). TCE concentrations in the Sandwich Road lobe have decreased significantly from baseline concentrations since startup of the Sandwich Road ETR. The highest TCE concentration was 3, 400 µg/l in the baseline plume delineation. In 2001, the maximum concentration dropped to 1,200 µg/L (AFCEE, 2002b).

- CS-10 In-Plume ETI System: The central portion of the plume (i.e., in-plume, southern lobe, and southwestern lobe) are addressed by the CS-10 In-Plume ETI treatment system. The placement of a treatment system within the plume reduces higher concentrations of contaminants for aquifer restoration. Extracted and treated groundwater is discharged into two infiltration trenches. The CS-10 In-Plume ETI System began operation on June 24, 1999. Three additional CS-10 S/SW extraction wells came on-line on April 27, 2000. The treatment system has removed approximately 543 kg of contaminants since startup through December 2001 (AFCEE, 2002a). Contaminant concentrations in the in-plume area, southern lobe, and southwestern lobe have generally decreased as a result of the CS-10 In-Plume extraction system.

Institutional and Engineering Controls:

Institutional and engineering controls for base residents/workers and offbase residents are in place to mitigate exposure pathways to humans.

C. PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

The following activities were conducted/observed since the last review:

- CS-10 Sandwich Road ETR system startup on May 18, 1999.
- CS-10 In-Plume System startup on June 24, 1999.
- CS-10 S/SW extraction wells come on-line on April 27, 2000.
- CS-10 Interim Remedial Action Report completed in May 2001. (AFCEE, 2001a)
- CS-10 Remedial Investigation (for leading edge) completed in September 2001 (AFCEE, 2001b)

D. TECHNICAL ASSESSMENT

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on USEPA guidance provided in section 4.0 of the Comprehensive Five-Year Review Guidance (USEPA 2001). **Table D-1** summarizes the technical assessment.

Question A: Is the remedy functioning as intended by the decision documents?

Yes, the interim remedy is functioning as intended by the IROD and CS-10 Plume Response Decision Factsheet. AFCEE is currently completing the IROD to ROD process, which may alter the interim remedy based on results of current groundwater monitoring data and system remedial performance data, as well as conclusions of risk assessments using current data. System performance monitoring results provided below were obtained from the *Storm Drain-5 and Chemical Spill-10 Semiannual System Performance and Ecological Impact Monitoring Report July-December 2001* (AFCEE, 2002a) and the *Final Combined Storm Drain –5 and Chemical Spill-10 2001 Annual Performance and Ecological Impact Monitoring Report* (AFCEE, 2002b).

CS-10 Sandwich Road ETR System Performance Monitoring Results

Since the beginning of system operation, the mass and volume of the CS-10 Sandwich Road plume have diminished. However, the measured TCE recovery is less than model-predicted because zones of elevated concentrations within the Sandwich Road plume are not as wide and thick as previously assumed. AFCEE optimized the system in Feburary 2002. Extraction rates of the seven operating wells will be increased as well as adjusting extraction well screen lengths to target the observed location of the TCE plume.

CS-10 In-Plume System Performance Monitoring Results

The CS-10 In-Plume system is functioning as intended. No changes are recommended to the system. Institutional/engineering controls that prohibit the use of contaminated groundwater that are in place have mitigated exposure pathways to humans.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered

There have been no changes in standards or TBC guidance.

Changes in Exposure Pathways

There have been no changes to exposure pathways and land use of the site that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics

There have been no changes in the toxicity factors for COCs.

Changes in Risk Assessment Methods:

There were no changes in risk assessment methodology.

Expected Progress Towards Meeting RAOS:

Treatment and capture of CS-10 plume contaminants by remedial systems have reduced or prevented the continued migration of these contaminants. The CS-10 Sandwich Road extraction system has been optimized to achieve RAOs. The CS-10 In-Plume system is expected to achieve RAOs.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

No.

Technical Assessment Summary:

A	Is the removal action functioning as intended by the decision documents?	Yes
B	Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the removal action selection are still valid?	Yes
C	Has information come to light that calls into question the protectiveness of the remedy?	No

E. ISSUES

The remaining issues at CS-10 groundwater include: selection of a final remedy for the entire plume including the leading edge; and continued operation and maintenance of remedial systems including monitoring and optimization, as needed.

F. RECOMMENDATIONS AND FOLLOW-UP ACTIONS

The recommendations and follow-up actions are: continue the system performance and ecological impact monitoring program for the remedial systems; and continue the RI/FS process to reach a final ROD (i.e., finalize the FS; issue a Proposed Plan for public comment period; and select a remedy in a ROD).

G. PROTECTIVENESS STATEMENT

The remedy is expected to be protective of human health and the environment upon attainment of groundwater cleanup goals. In the interim, exposure pathways that could result in unacceptable risks are being controlled by the operation of the CS-10 treatment systems and institutional/engineering controls that prohibit the use of contaminated groundwater.

All threats at the site have been addressed by the implementation of the remedy (i.e., operation of the CS-10 treatment systems and institutional/engineering controls that prohibit the use of contaminated groundwater).

Long-term protectiveness of the remedial action will be verified by results of groundwater monitoring and system remedial performance monitoring. Current monitoring data indicate that the remedy is functioning as required to achieve groundwater cleanup goals.

H. REFERENCES

AFCEE, 1997 *CS-10 Plume Response Decision Fact Sheet*. Prepared by AFCEE, Installation Restoration Program, Otis ANG Base, MA December 1997

AFCEE, 2001a. *Final Chemical Spill-10 Interim Remedial Action Report.* Prepared by AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA. May 2001

AFCEE, 2001b. *Final Chemical Spill-10 Remedial Investigation Report.* Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA. September 2001

AFCEE, 2002a. *Storm Drain-5 and Chemical Spill-10 Semiannual System Performance and Ecological Impact Monitoring Report July –December 2001.* Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA. April 2002

AFCEE, 2002b. *Final Combined Storm Drain-5 and Chemical Spill-10 2001 Annual System Performance and Ecological Impact Monitoring Report.* Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA. July 2002

ANG, 1995. *Final Record of Decision Interim Remedial Action Containment of Seven Groundwater Plumes at MMR, Cape Cod MA Prepared* by Stone & Webster Environmental & Technology Services for ANG Readiness Center, Installation Restoration Program, Otis ANG Base, MA. September 1995

USEPA, 2001. *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007, June 2001.

9.3.10 CHEMICAL SPILL NO. 11 (CS-11) SOURCE

A. BACKGROUND

A.1 Site Description

Area of concern (AOC) CS-11 is approximately 0.5 acres and is located between South Outer Road and Asphalt Road on the MMR. CS-11 consists of Building 1116, which was used by the ANG and ARNG as a pesticide shop for storage and mixing of pesticides and herbicides (**Figure 11**).

This study area was identified in the Task 6 Records Search as an area of potential contamination (E.C. Jordan Co, 1986). According to the records search, from 1970 to 1983, pesticides and herbicides were mixed on an asphalt pad located on the eastern side of Building 1116. Reportedly, pesticides spilled during mixing were washed off the edge of the pad onto the surrounding soil. No major pesticide spills were ever reported and pesticides are not currently stored at AOC CS-11. In 1983, when the pesticide shop was closed, approximately 200 pounds of pesticides were removed from Building 1116. These included traditional chlorinated compounds such as Lindane, and more modern organophosphorus pesticides including Malathion and Sevin. No documentation has been found that other pesticides such as 4,4'-DDT and dieldrin were stored in Building 1116, although they have been detected in other environmental media at MMR.

A.2 Basis for Taking Action

Site Investigation (SI): A SI was completed in October 1993 intended to determine the nature and extent of contamination at CS-11 (ABB-ES, 1993). The investigation phase included the completion of five test pits and one monitoring well (MW-1). Pesticides detected included 4,4'-DDT, dieldrin, heptachlor, and methoxychlor. No herbicides or organophosphorus pesticides were detected in surface soil. TAL inorganic analytes with the exception of selenium and thallium were detected in all surface soil sample locations. These analytes included arsenic, barium, cadmium, chromium, copper, cyanide, lead, mercury, and zinc.

Based on results of chemical analysis, it appears that pesticide spills occurred on the ground around the asphalt pad on the eastern side of Building 1116. Detected concentrations of dieldrin at one test pit location appear higher than those observed at other study areas where normal use of the pesticide occurred, indicative of a spill (ABB-ES, 1993).

To identify potential risks associated with exposures to study-area-related contaminants of potential concern, a site-wide risk evaluation was conducted for surface soil including both human-health and ecological exposure scenarios. Results of the ecological and human health risk evaluations triggered the need for an alternative evaluation. Contaminants of concern (COCs) identified at AOC CS-11 included cadmium, chromium, lead, zinc, cyanide, and dieldrin. The Priority 2 and 3 Study Areas SI Report recommended non-time-critical removal actions at CS-11.

Engineering Evaluation/Cost Analysis (EE/CA): AOC CS-11 was included as part of the Priority 2 and 3 Study Areas and Drum Disposal Operable Unit (DDOU) EE/CA completed in October 1998 (AFCEE, 1998).

Alternatives that received detailed analysis in the EE/CA were:

- Alternative 1: On-Base Thermal Desorption and Off-base Treatment and Disposal for AOC CS-11
- Alternative 2: On-Base Asphalt batching and Off-Base Treatment and Disposal for AOC CS-11
- Alternative 3: Off-base Treatment and /or Disposal of soil for AOC CS-11.

B. REMEDIAL/REMOVAL ACTIONS:

This section presents the regulatory actions, removal action objectives (RAOs), a description of the selected removal action, and a summary of the removal action implementation at AOC CS-11.

B.1 Regulatory Actions

Described below are controlling documents that present the selected removal action and post-Action Memorandum (AM) documents that identified changes to the selected removal action.

Action Memorandum: The Priority 2 and 3 Study Areas and DDOU Source Removal AM (AFCEE, 1999) was prepared to document the decision to perform removal actions at certain Priority 2 and 3 Study Areas including CS-11. Based on the evaluation of removal action alternatives presented in the EE/CA, the selected alternative was Alternative 2 which included excavating AOC CS-11 soil and treating the excavated material on-base using an asphalt batching facility and/or off-base at an approved treatment and disposal facility.

Action Memorandum Addendum: An AM Addendum was prepared to document changes to the selected removal action for several sites in the Source Area Remedial Action Program (SARAP) including CS-11 (AFCEE, 2003). Three changes were made to the selected removal action presented in the Priority 2 and 3 Study Areas EE/CA: (1) establishment of removal action levels (RALs) for certain inorganic chemicals and PCBs; (2) removal of the asphalt-batching component from the selected removal action; and (3) the expansion of offsite disposal options to include RCRA Subtitle D facilities.

B.2 Removal Action Objectives

The RAOs are site-specific qualitative goals that must be achieved to meet remedial response objectives. The RALs are the site-specific quantitative cleanup levels that will meet these goals. The remedial response objectives include the removal of surface soil around the wash pad to reduce the risk of human and ecological exposure to dieldrin and several inorganics.

MMR-specific Soil Target Cleanup Levels (STCLs) used for the DSRP (AFCEE, 1996) were retained and used to develop cleanup levels for identified COCs. In 2000, AFCEE with concurrence from USEPA and MADEP revised ecological risk based STCLs for inorganic chemicals in a Technical Memorandum (AFCEE, 2000). In addition, AFCEE used USEPA screening level guidance for Superfund sites as the RAL for PCBs. In 2002, AFCEE revised phytotoxicity and invertebrate STCLs for several inorganics in an addendum to the Technical Memorandum (AFCEE, 2002).

The revised STCLs led to the development of RALs, which also took into account terrestrial plant screening levels, terrestrial invertebrate screening levels, and MMR-specific background levels. Development and establishment of RALs were documented in an Action Memorandum Addendum

(AFCEE, 2003). Presented in **Table B-1** are RALs that must be achieved to meet remedial response objectives for CS-11.

Cadmium	Ecological	1.8
Chromium	Background	19
Lead	Ecological	99
Cyanide	Background	1
Dieldrin	Ecological	.035
Zinc	Ecological	68

B.3 Removal Action Description

The selected removal action documented in the AM (AFCEE, 1999) consisted of excavating contaminated soil and treating this material on-base using an asphalt batching facility and/or off-base at an approved treatment and disposal facility. Excavated soil determined to exceed TCLP allowable concentrations and therefore deemed hazardous would be disposed off-site in a RCRA Subtitle C TSDF. Soil determined to be below TCLP allowable concentrations and therefore nonhazardous (and that were determined to contain contaminant concentrations below MADEP MCP Method 1 S-1/GW-1 standards for pesticides and Massachusetts Permitted Soil Recycling Facility Summary Levels) would be treated at the on-site cold mix emulsion asphalt-batching plant. Post excavation confirmatory sampling would be conducted to ensure that all soil with COC concentrations exceeding CS-11 soil cleanup levels were removed.

The selected removal action for AOC CS-11 has been modified. Changes to the selected removal action included deletion of the on-site asphalt batching component of the removal action; establishment of RALs to replace cleanup levels presented in the AM; and expansion of offsite disposal options to include RCRA Subtitle D facilities. These changes are documented in Priority 2 and 3 Study Areas and DDOU Source Removal AM Addendum for the SARAP (AFCEE, 2003).

The modified removal action consisted of excavating contaminated soil at AOC CS-11. Excavated soil would be transported to an on-base central bulking facility for waste characterization. Excavated soil that has contaminant concentrations in exceedance of TCLP allowable concentrations and therefore deemed hazardous would be disposed off-site in a RCRA Subtitle C TSDF. Soil that has contaminant concentrations below TCLP allowable concentrations and therefore deemed nonhazardous (and that are determined to contain contaminant concentrations below MADEP MCP Method 1 S-1/GW-1 standards for pesticides and Massachusetts Permitted Soil Recycling Facility Summary Levels) would be transported offsite to a Subtitle D facility.

B.4 Removal Action Implementation

AFCEE conducted a removal action in 2001 and 2002 at AOC CS-11. Approximately 700 cubic yards of contaminated soil was excavated from AOC CS-11. All the excavated soil was considered RCRA-hazardous (P037) and was disposed of at a RCRA Subtitle C incinerator and RCRA Subtitle C landfill.

C. PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

The following activities were conducted since the last review.

- Priority 2 and 3 Study Areas and DDOU AM: Completed in June 1999
- Removal Action: Completed in April 2002
- Priority 2 and 3 Study Areas and DDOU AM Addendum: Completed in February 2003.

D. TECHNICAL ASSESSMENT

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy/removal action. AFCEE performed the technical assessment based on USEPA guidance provided in section 4.0 of the Comprehensive Five-Year Review Guidance (USEPA 2001).

Question A: Is the remedy functioning as intended by the decision documents?

The review of documents, ARARs, risk assumptions, and the results of the site inspection indicate that the removal action has been completed as intended by the AM and modified by the AM Addendum. The excavation and offsite disposal of contaminated soil has achieved the RAOs of mitigating the migration of contaminants to groundwater and preventing direct contact with, or ingestion of contaminants in soil.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered

As the removal has been completed, ARARs and TBC guidance for soil contamination cited in the AM and AM Addendum have been met. There have been no changes in chemical-specific ARARs and TBC guidance. AFCEE recalculated risk-based STCLs for ecological receptors to reflect current toxicity information. RALs were derived from the comparison of the following: revised STCLs, background, phytotoxicity screening levels, and invertebrate screening levels. The new cleanup levels remain protective of human health and the environment. Cleanup levels identified in the AM were derived from the comparison of cleanup levels used in the DSRP and background. These cleanup levels initially did not take into account invertebrate or phytotoxicity screening levels; however, they were taken into account in the AM Addendum.

Table D-1 presents changes in cleanup levels at CS-11.

Cadmium	Soil	1.8	1.5
Chromium	Soil	19	6.8
Lead	Soil	99	15.8
Zinc	Soil	68	16

Changes in Exposure Pathways

There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the removal action.

Changes in Toxicity and Other Contaminant Characteristics

There have been no changes in the toxicity factors for contaminants of concern that were used for the human health risk assessment. However, risk-based cleanup levels for ecological receptors were calculated using new toxicity information. Calculation of ecological risk-based STCLs using new toxicity information was completed in 2000 (AFCEE, 2000). These STCLs were used in the development of RALs (AFCEE, 2003). Cleanup was based on these RALs.

Changes in Risk Assessment Methods:

There were no changes in human health risk assessment methodology.

Expected Progress Towards Meeting RAOS:

Implementation of the removal action has achieved RAOs.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

There is no information that calls into question of the protectiveness of the selected removal action.

Technical Assessment Summary

The removal action has been completed as intended by the AM modified by the AM Addendum. There have been no changes in the physical conditions and land use of the site that would affect the protectiveness of the removal action. The removal has been completed, ARARs and TBC guidance for soil contamination cited in the AM and AM Addendum have been met. There is no information that calls into question of the protectiveness of the selected removal action.

Table D-2 presents the technical assessment summary for AOC CS-11.

A	Is the removal action functioning as intended by the decision documents?	Yes
B	Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the removal action selection are still valid?	Yes
C	Has information come to light that calls into question the protectiveness of the removal action?	No

E. ISSUES

The issue at CS-11 is that a removal action report documenting the cleanup actions has not been completed.

F. RECOMMENDATIONS AND FOLLOW-UP ACTIONS

The recommendation and follow-up action is to prepare and issue the final removal action report with regulatory review and comment.

G. PROTECTIVENESS STATEMENT

The removal action selected for the AOC CS-11 (source control including excavation and off-site disposal) is protective of human health and the environment. Soil containing COCs above RALs have been removed.

H. REFERENCES

ABB-ES, 1993. *Priority 2 and 3 Study Areas Site Investigation*. Installation Restoration Program, Massachusetts Military Reservation, prepared for HAZWRAP; Portland, Maine; October 1993.

AFCEE, 2003. *Action Memorandum Addendum Priority 2 and 3 Study Areas and Drum Disposal Unit Source Removal*. Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program; February 2003.

AFCEE, 2002. *Addendum to Technical Memorandum Revised Ecological Soil Target Cleanup Levels For Inorganics*. Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program; September 2002.

AFCEE, 2000. *Final Technical Memorandum Revised Ecological Soil Target Cleanup Levels For Inorganics.* Prepared by HAZWRAP for AFCEE/MMR Installation Restoration Program; December 2000.

AFCEE, 1999. *Action Memorandum Priority 2 and 3 Study Areas and Drum Disposal Operable Unit Source Removal*. Prepared by Harding Lawson Associates (HLA) for AFCEE/MMR Installation Restoration Program; June 1999.

AFCEE, 1998. *Priority 2 and 3 Study Areas Drum Disposal Operable Unit Engineering Evaluation/Cost Analysis.* Prepared by HLA for AFCEE/MMR Installation Restoration Program; October 1998.

AFCEE, 1996. *Soil Target Cleanup Levels, DSRP*. Prepared by HAZWRAP for AFCEE/MMR Installation Restoration Program; January 1996.

E.C. Jordan Co., 1986. *U.S. Air Force Installation Restoration Program Phase I: Records Search, Air National Guard, Camp Edwards, U.S. Air Force, and Veterans Administration Facilities at Massachusetts Military Reservation, Task 6*; Installation Restoration Program, Massachusetts Military Reservation; prepared for Oak Ridge National Laboratory; Oak Ridge, Tennessee; December 1986.

USEPA, 2001. *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007; June 2001.

9.3.11 CHEMICAL SPILL NO.16 (CS-16) & CHEMICAL SPILL NO.17 (CS-17) SOURCE

A BACKGROUND

A.1 Site Description

Areas of Contamination (AOCs) Chemical Spill-16 (CS-16)/Chemical Spill-17 (CS-17) occupy approximately 80 acres along the southern MMR boundary near the Falmouth gate entrance to the MMR (**Figure 11**).

CS-16/CS-17 is bounded to the north by Kittridge Road and an abandoned utility pole, on the east by Sandwich Road, and on the south and west by the MMR boundary. CS-16/CS-17 consists of infiltration sand filter and sludge drying beds located adjacent to the former MMR Sewage Treatment Plant (STP). The former STP disposed of treated effluent by discharging it to these sand filter beds. In the past, waste battery electrolyte, cleaners, solvents, and paint thinners from various operations at MMR are believed to have been discharged to the sanitary sewer system. The former STP was decommissioned in 1997. As a result, none of the sand filter beds or sludge drying beds at CS-16/CS-17 is currently in use. The former STP was replaced with the current upgraded STP, and discharge effluent is piped off-site to new sand filter beds located near the Cape Cod Canal.

A.2 Initial Responses

One non-CERCLA action was conducted at the CS-16/CS-17. The MMR Sewage Treatment Plant Upgrade Program upgraded the former STP to discharge effluent to new sand filter beds near the Cape Cod Canal. During the upgrades program, all above ground structures were removed to approximately 3 feet below grade. Demolition debris was placed into abandoned clarifier and trickling filter tanks and left in place. The demolition of the STP structures was completed in 1997. There was minimal disturbance to the sand filter beds, sludge drying beds and bed liners during demolition activities.

A.3 Basis for Taking Action

Several studies were conducted at CS-16/CS-17 to determine the nature and extent of contamination. Contaminants of concern identified at CS-16/CS-17 included arsenic, chromium, copper, lead, zinc, Arochlor 1254, dieldrin, and methylene chloride. Provided below is a summary of investigation activities that provided a characterization of the site.

Site Investigation: Several Site Investigations (SI) were completed at CS-16/CS-17. In 1990, SI activities included the completion of eleven soil borings with selected monitoring wells and the collection of 31 soil samples. Results indicated that surface soil from the inactive sand filter beds contained potentially significant concentrations of pesticides, PCBs and SVOCs (E.C. Jordan, 1990a). Additional SI sampling conducted in 1990 addressed data gaps from previous investigations. Activities consisted of the collection of two soil samples from beneath sludge piles. Results indicated that elevated concentrations of SVOCs and lead were present in the sludge piles, and elevated concentrations of metals in shallow soil samples from beneath the sludge piles, indicating that metals leached from the sludge (E.C Jordan, 1990b).

Remedial Investigation/ Feasibility Study: A Remedial Investigation (RI) of the CS-16/CS-17 Site was conducted in 1996 (ABB-ES, 1996). CS-16/CS-17 was divided into seven areas: (1) active

sand filter beds, (2) inactive sand filter beds, (3) abandoned sand filter beds (4) active sludge drying beds, (5) inactive sludge drying beds, (6) abandoned sludge drying beds, and (7) the former sewage sludge disposal area. Three areas contained contaminants at elevated levels. These areas are discussed below:

Active Sludge Drying Beds: Sludge at the active sludge drying beds was contaminated with pesticides, PCBs, and metals. Physical examination of the soil in these sludge beds identified less than six (6) inches of sludge in these beds.

Inactive Sludge Drying Beds: Laboratory analytical data indicated that the inactive sludge drying beds were contaminated with dieldrin, PCBs, and metals. These analytes are not uniformly distributed among the beds.

Former Sewage Disposal Area: Sludge samples contained barium, chromium, copper, iron, lead, mercury, selenium, silver, zinc, and cyanide at concentrations exceeding MMR background concentrations for surface soil. Soil samples collected beneath the piles contained concentrations of chromium, copper, lead, mercury, and zinc at concentrations exceeding MMR background concentrations for surface soil. Detectable concentrations of pesticides (DDT and isomers) were also present in the samples,

A FS was completed in September 1998 (AFCEE, 1998b). Results of the ecological and human health risk assessments triggered the need for an alternative evaluation. Alternatives that received detailed analysis in the FS were:

- No Action
- Permeable Cover
- Impermeable Cap
- Excavation, Asphalt Batching/On-site Treatment, and Off-site Disposal
- Excavation and Off-site Disposal

B. REMEDIAL ACTIONS:

This section presents the regulatory actions, RAOs, remedy description, and a summary of the remedy implementation at CS-16/CS-17.

B.1 Regulatory Actions

Described below are controlling documents that present the selected remedy and post-ROD documents that identified changes to the selected remedy.

Proposed Plan/Record of Decision: A proposed plan was issued by AFCEE in 1998 for public comment (AFCEE, 1998a). The proposed remedy (Alternative 4 in the FS) consisted of excavation of contaminated surface soil at three source areas [i.e., "active" sludge drying beds, inactive sludge drying beds, and former sewage sludge disposal area]; on-site cold-mix asphalt batching of recyclable excavated soil; off-site disposal of non-recyclable excavated soil at a RCRA Subtitle C facility; and post excavation confirmatory sampling to ensure that all soil with COC concentrations exceeding CS-16/CS-17 soil cleanup levels were removed.

The ROD was finalized in May 1999 and documented the selected remedy (AFCEE, 1999). The selected remedy was the same as the proposed remedy because there were no changes resulting from the public comments received as part of the Proposed Plan process. However, at the request of MADEP, confirmation samples for mercury, which was not selected as a COC, would be collected after remedial action at the former sewage sludge disposal area.

Explanation of Significant Differences: An Explanation of Significant Differences (ESD) was prepared to document changes to the selected remedy for several sites in the Source Area Remedial Action Program (SARAP) including CS-16/CS-17 (AFCEE, 2003). Three changes are made to the selected remedy presented in CS-16/CS-17 ROD: (1) establishment of removal action levels (RALs) for certain inorganic chemicals and PCBs; (2) removal of the asphalt-batching component from the selected remedy; and (3) the expansion of offsite disposal options to include RCRA Subtitle D facilities.

B.2 Remedial Action Objectives

The RAOs are site-specific qualitative goals that must be achieved to meet remedial response objectives. The RALs are the site-specific quantitative cleanup levels that will meet these goals. The remedial response objectives include: (1) reduce exposure to ecological receptors from metals at the active sludge drying beds, inactive sludge drying beds, and the former sewage disposal area and (2) reduce exposure of ecological receptors to PCBs and dieldrin at the active sludge drying beds and inactive sludge drying beds.

MMR-specific Soil Target Cleanup Levels (STCLs) used for the DSRP (AFCEE, 1996) were retained and used to develop cleanup levels for identified COCs. In 2000, AFCEE with concurrence from USEPA and MADEP revised ecological risk based STCLs for inorganic chemicals in a Technical Memorandum (AFCEE, 2000). In addition, AFCEE used USEPA screening level guidance for Superfund sites as the RAL for PCBs (AFCEE, 2003).

In 2002, AFCEE revised phytotoxicity and invertebrate STCLs for several inorganics in an addendum to the Technical Memorandum (AFCEE, 2002).

The revised STCLs led to the development of RALs, which also took into account terrestrial plant screening levels, terrestrial invertebrate screening levels, and MMR-specific background levels. Development and establishment of RALs were documented in an ESD prepared in 2003 (AFCEE, 2003). Presented in **Table B-1** are RALs that must be achieved to meet remedial response objectives for CS-16/CS-17.

Aroclor 1254	Ecological	1
Dieldrin	Ecological	.035
Arsenic	Ecological	7.10
Chromium	Ecological	19
Copper	Ecological	61
Lead	Ecological	99
Zinc	Ecological	68

B.3 Remedy Description

The selected remedy documented in the ROD (AFCEE, 1999) consisted of excavation of contaminated surface soil at the three source areas (i.e., "active" sludge drying beds, inactive sludge drying beds, and former sewage sludge disposal area). Excavated soil that had contaminant concentrations in exceedances of TCLP allowable concentrations would require off-site transportation and disposal at a RCRA Subtitle C TSDF. Soil that had contaminant concentrations below TCLP allowable concentrations were deemed nonhazardous (and that have contaminant concentrations below MADEP MCP Method 1 S-1/GW-1 standards for pesticides and Massachusetts Permitted Soil Recycling Facility Summary Levels) would be processed at the on-site cold mix emulsion asphalt-batching plant. Post excavation confirmatory sampling would be conducted to ensure that all soil with COC concentrations exceeding CS-16/CS-17 soil cleanup levels were removed.

At the request of the MADEP, confirmation samples for mercury analysis were collected as part of the remedial action at CS-16/CS-17 although mercury was not a COC. To support the soil removal, samples were analyzed for mono-methyl mercury because the ecological risk-based STCL for mercury is 0.18 mg/kg. No methyl mercury was detected in samples collected at CS-16/CS-17. The selected remedy for CS-16/CS-17 was modified. Changes to the selected remedy included deletion of the on-site asphalt batching component of the remedy; establishment of RALs to replace cleanup levels presented in the ROD; and expansion of offsite disposal options to include RCRA Subtitle D facilities. These changes are documented in an ESD for the Source Area Remedial Action Program (SARAP) (AFCEE, 2003).

The modified remedy consisted of excavating contaminated surface soil at three source areas. Excavated soil was transported to an on-base central bulking facility for waste characterization. Excavated soil that was determined to exceed TCLP allowable concentrations and therefore deemed hazardous was disposed off-site in a RCRA Subtitle C TSDF. Soil that was determined to be below TCLP allowable concentrations and therefore nonhazardous (and that are determined to contain contaminant concentrations below MADEP MCP Method 1 S-1/GW-1 standards for pesticides and Massachusetts Permitted Soil Recycling facility Summary Levels) was transported offsite to a Subtitle D facility.

B.4 Remedy Implementation

AFCEE conducted remedial activities in 2001 at CS-16/CS-17. Soil with concentrations of mercury below 10 mg/kg (approximately 3,195 cubic yards) was combined with soil from other similar disposal requirements. Composite sampling of the consolidated soil stockpiles determined that the consolidated soil was considered non-hazardous and suitable for reuse as daily cover at a Resource Conservation and Recovery Act (RCRA) Subtitle D Landfill. CS-16/CS-17 soil was disposed of at the Taunton Landfill, in compliance with the MADEP *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy #COMM-97-001*.

Soil with concentrations of mercury above 10 mg/kg (approximately 837 cubic yards) was stockpiled separately from the remaining excavated soil. Waste characterization indicated that this soil exceeded the MADEP Landfill Reuse Levels making them ineligible for disposal in the State of Massachusetts. This soil was transported to the Turnkey Landfill in Rochester, New Hampshire, for disposal. The Turnkey Landfill is a permitted RCRA Subtitle D landfill.

C. PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

The following activities were conducted since the last review.

- ROD: Completed in May 1999
- Remedial Action: Completed in October 2001
- ESD: Completed in January 2003

D. TECHNICAL ASSESSMENT

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on USEPA guidance provided in section 4.0 of the Comprehensive Five-Year Review Guidance (USEPA, 2001).

Question A: Is the remedy functioning as intended by the decision documents?

The review of documents, ARARs, risk assumptions, and the results of the site inspection indicate that the remedy has been completed as intended by the ROD modified by the ESD. The excavation and offsite disposal of contaminated soil has achieved the RAOs of mitigating the migration of contaminants to groundwater and preventing direct contact with, or ingestion of contaminants in soil.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Changes in Standards and To Be Considered

ARARs and TBC guidance for soil contamination cited in the ROD and ESD have been met. Changes to the cleanup levels were made after the publication of the ROD. These changes were considered in the ESD. AFCEE recalculated risk-based STCLs for ecological receptors to reflect current toxicity information. Cleanup levels in the ROD were derived from the comparison of cleanup levels used in the DSRP and background levels. The new cleanup levels remain protective of human health and the environment. Cleanup levels for identified in the ROD were derived from the comparison of cleanup levels used in the DSRP and background. These cleanup levels initially did not take into account invertebrate or phytotoxicity screening levels; however, they were taken into account in the ESD. **Table D-1** presents the changes in cleanup levels.

Arochlor 1254	Soil	1	1.25
Arsenic	Soil	7.1	3.6
Chromium	Soil	19	6.8
Copper	Soil	61	19.3
Lead	Soil	99	15.8
Zinc	Soil	68	16

Changes in Exposure Pathways

There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics

There have been no changes in the toxicity factors for contaminants of concern that were used for the human health risk assessment. However, risk-based cleanup levels for ecological receptors were calculated using new toxicity information. Calculation of ecological risk-based STCLs using new toxicity information was completed in 2000 (AFCEE, 2000). These STCLs were used in the development of RALs. Cleanup was based on these RALs.

Changes in Risk Assessment Methods:

There were no changes in human health risk assessment methodology.

Expected Progress Towards Meeting RAOS:

Implementation of the remedy has achieved RAOs.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

There is no information that calls into question of the remedy.

Technical Assessment Summary

The remedy was completed as intended by the ROD and ESD. There have been no changes in the physical conditions and land use of the site that would affect the protectiveness of the remedy. ARARs and TBC guidance for soil contamination cited in the ROD and ESD have been met. There is no information that calls into question of the remedy.

Technical Assessment Summary:

Table D-2 presents the technical assessment summary for AOC CS-16/17.

A	Is the removal action functioning as intended by the decision documents?	Yes
B	Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the removal action selection are still valid?	Yes
C	Has information come to light that calls into question the protectiveness of the removal action?	No

E. ISSUES

The issue at CS-16/CS-17 is finalization of the remedial action report, which documents the cleanup actions.

F. RECOMMENDATIONS AND FOLLOW-UP ACTIONS

The recommendation and follow-up action is to finalize the final remedial action report after receiving regulatory approval.

G. PROTECTIVENESS STATEMENT

The remedy for AOC CS-16/CS-17 (source control including excavation and off-site disposal) is protective of human health and the environment. Soil containing COCs above RALs have been removed.

H. REFERENCES

ABB-ES, 1996. *Final Remedial Investigation Report, Sewage Treatment Plant/Former Sewage Sludge Disposal Area, Area of Contamination CS-16/CS-17*, Installation Restoration Program, Massachusetts Military Reservation, January 1996.

AFCEE, 2003. *Action Memorandum Addendum Priority 2 and 3 Study Areas and Drum Disposal Unit Source Removal*. Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program; February 2003.

AFCEE, 2002. *Addendum to Technical Memorandum Revised Ecological Soil Target Cleanup Levels For Inorganics*. Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program; September 2002.

AFCEE, 2000. *Final Technical Memorandum Revised Ecological Soil Target Cleanup Levels For Inorganics.* Prepared by HAZWRAP for AFCEE/MMR Installation Restoration Program; December 2000.

AFCEE, 1999. *Record of Decision Area of Contamination CS-16/CS-17*, Prepared by HAZWRAP for AFCEE/MMR Installation Restoration Program, May 1999.

AFCEE, 1998b. *Final Feasibility Study Area of Contamination: CS-16/CS-17*, Prepared by HAZWRAP for AFCEE/MMR Installation Restoration Program, September 1998.

AFCEE, 1998a. *Proposed Plan to Cleanup Source Areas at the Chemical Spill No.16/Chemical Spill No. 17, Air Force Center for Environmental Excellence*, August 1998

AFCEE, 1996. *Soil Target Cleanup Levels, DSRP*. Prepared by HAZWRAP for AFCEE/MMR Installation Restoration Program; January 1996.

E.C. Jordan Co., 1990b. *Site Inspection Report Addendum- Results of Additional SI Sampling Conducted Summer 1989, Task 2-3C*, Installation Restoration Program, Massachusetts Military Reservation, March, 1990

E.C. Jordan Co., 1990a. *Site Inspection Report Addendum- Field Investigation Work Conducted Fall 1987*, Installation Restoration Program, Massachusetts Military Reservation, December, 1990

MADEP, 1994. *Interim Remediation Waste Policy for Petroleum Contaminated Soils,* MADEP Bureau of Waste Site Cleanup, WSC-94-400, 1994.

USEPA, 2001. *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007, June 2001.

9.3.12 CHEMICAL SPILL NO.20 (CS-20) GROUND WATER

A. BACKGROUND

A.1 Site Description

The CS-20 plume is a chlorinated VOC plume and was first detected in 1997 during the FS-28 RI drilling program. The CS-20 plume is a component of the SWOU, which also includes the CS-4 plume, CS-21 plume, FS-13 plume, FS-28 plume, and FS-29 plume. Based on site characterization activities conducted for the SWOU RI (AFCEE, 1999b), the CS-20 plume was approximately 700 feet wide and 5500 feet long, and had a maximum thickness of 100 feet. The plume underlies 40 to 70 feet of clean water. The location of the CS-20 Plume is presented in **Figure 9.3.12-1**. The extent of the CS-20 plume was defined in the SWOU RI. The plume consists primarily of PCE and other dissolved chlorinated solvents and is detached from the source area, the location of which is unknown. The plume does not discharge to surface water.

A.2 Initial Responses

AFCEE funded the town of Falmouth to extend public water supply lines and hook-up homes in neighborhoods potentially impacted by CS-20.

A.3 Basis for Taking Action

PCE has been identified as the contaminant of concern (COC) with concentrations as high as 71μg/l. Calculated risk for the CS-20 plume based on reasonable maximum exposure to future residents exceeds the MADEP allowable risk of $1x10^{-5}$.

B. REMEDIAL ACTIONS

This section presents the regulatory actions, RAOs, and remedy description for the CS-20 Plume.

B.1 Regulatory Actions

The Final Record of Decision for the CS-4, CS-20, CS-21, and FS-13 Plumes (AFCEE, 2000) is the controlling document for the CS-20 plume. The selected remedy for the CS-20 plume includes design, construction, and operation of an extraction, treatment, and reinjection (ETR) system to hydraulically capture and treat contaminants; long-term monitoring of the plume; performance monitoring and evaluation of the treatment system; ecological sampling to monitor the impacts of the system to the environment; and institutional controls to protect residents from exposure to SWOU groundwater contaminants. The remedy (Alternative 5) was selected from the analysis of eight alternatives presented in the SWOU Feasibility Study (AFCEE, 1999b). The Proposed Plan presenting the preferred alternative was released to the public for comment in June 1999.

B.2 Remedial Action Objectives

Remedial Action Objectives to protect human health as presented in the ROD (AFCEE, 2000) are:

- Prevent or reduce residential exposure to PCE exceeding 5 μg/L in groundwater.

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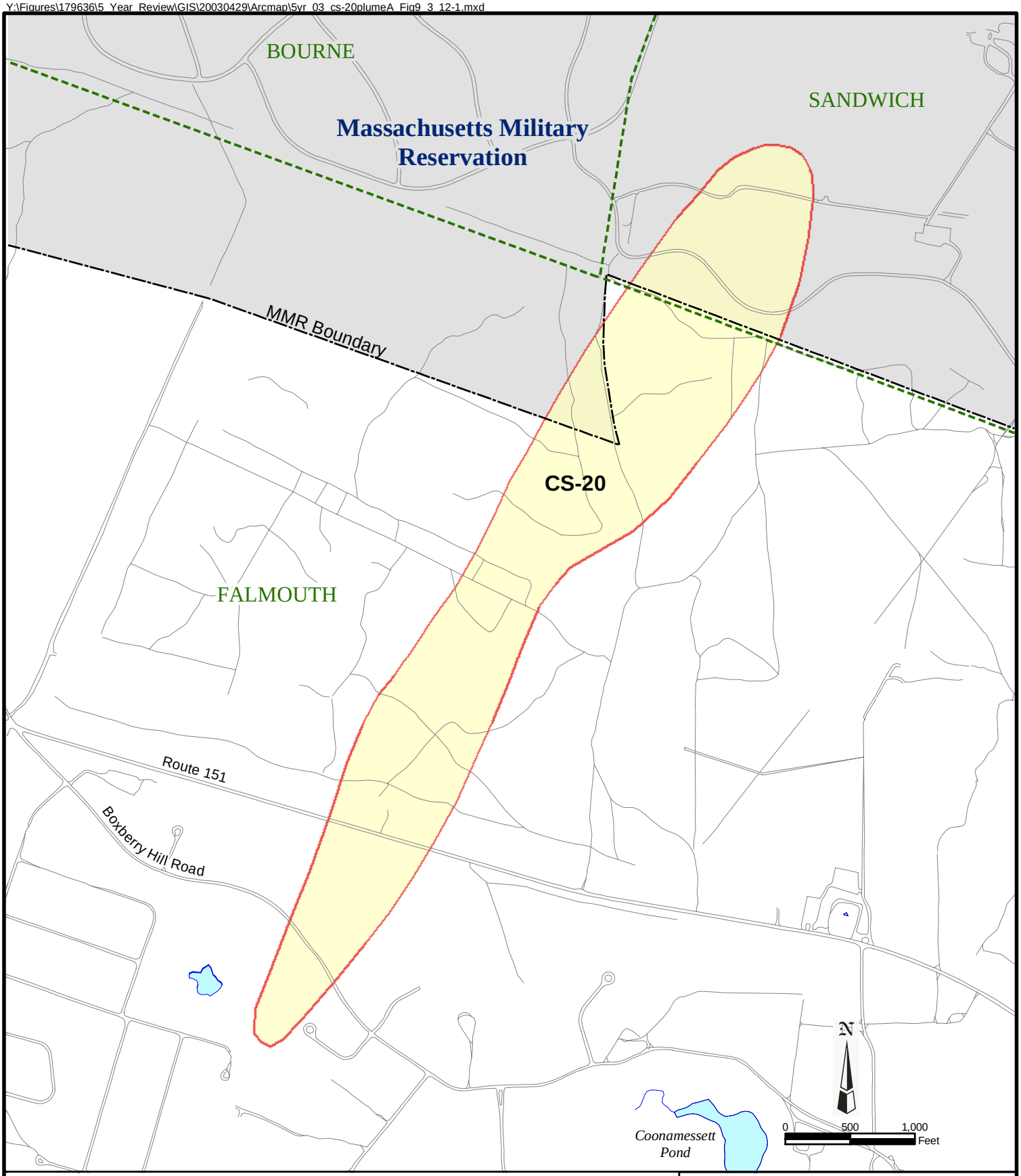

Legend

Plume Contour = Concentrations exceeding drinking water standards or Maximum Contaminant Level (MCL). Represents an exceedance of perchloroethene (PCE). (PCE MCL = 5 µg/L)

Town Boundary

Air Force Center for Environmental Excellence

Chemical Spill 20 (CS- 20) Plume
December 2002

Massachusetts Military Reservation
Cape Cod, Massachusetts

Figure 9.3.12-1

- Restore the aquifer (within confines of the CS-20 plume) to its beneficial uses within a reasonable timeframe.

B.3 Remedy Description

For all of the SWOU plumes, institutional and engineering controls have been implemented to protect off-post and on-post residents. For Falmouth residents, a permit is required from the Falmouth Board of Health prior to installation of a well for drinking water; if the permit is granted, water must be tested for VOCs and EDB prior to use. If the Falmouth Board of Health grants a permit for installation of a well that is located above a plume, AFCEE will regularly sample the well. Furthermore, AFCEE will sample drinking wells installed prior to the promulgation of the Falmouth Board of Health regulations that are located above the plume, within 500 feet crossgradient of the plume, or 1,500 feet downgradient of a plume for which public water connections are not provided. On-post residents and workers receive their water from the base water supply system.

The ETR system was modeled using a flow rate of 500 gpm. In the modeled scenario, three extraction wells each pumping 166 gpm would be processed through a pair of GAC units in series. The modeling estimated that the pumping scenario would be capable of capturing 99 percent of the plume after 24 years. The treated water would be discharged through an infiltration gallery or reinjection wells located west of the CS-20 plume and just north of Route 151. Please note that certain components of the conceptual design of the selected remedy are subject to change as a result of the Phase II Pre-Design Data Gap Investigation, which is scheduled to be completed in January 2003.

B.4 Remedy Implementation

At this time, the institutional controls component of the selected remedy has been implemented. With regard to the groundwater cleanup systems, AFCEE has completed the fieldwork of a design investigation. The wellfield design for CS-20 will be developed by Summer 2003.

C. PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

The following activities were conducted/observed since the last review.

- Final RI completed in May 1999 (AFCEE, 1999a)
- Final FS completed in June 1999 (AFCEE, 1999b)
- Final ROD completed in February 2000 (AFCEE, 2000)

D. TECHNICAL ASSESSMENT

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on USEPA guidance provided in section 4.0 of the Comprehensive Five-Year Review Guidance (USEPA 2001). **Table D-1** summarizes the answers to the technical assessment questions.

Question A: Is the remedy functioning as intended by the decision documents?

Yes, the remedy design specifications will be constructed in accordance with requirements of the ROD and optimized based on pre-design information. Furthermore, institutional controls are in place to mitigate exposure to humans from contaminated groundwater.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered

There have been no changes in standards or TBC guidance.

Changes in Exposure Pathways

There have been no changes to exposure pathways and land use of the site that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics

There have been no changes in the toxicity factors for COCs.

Changes in Risk Assessment Methods:

There were no changes in risk assessment methodology.

Expected Progress Towards Meeting RAOS:

The remedy is currently in the design phase. The implementation of remedy is expected to restore the aquifer to beneficial purposes. Institutional and engineering controls have achieved the RAO of preventing exposure to humans from chlorinated VOCs in groundwater.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

There is no information that calls into question the protectiveness of the remedy.

A	Is the removal action functioning as intended by the decision documents?	Yes
B	Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the removal action selection are still valid?	Yes
C	Has information come to light that calls into question the protectiveness of the remedy?	No

E. ISSUES

The issue at CS-20 groundwater is: the groundwater extraction and treatment component of the selected remedy needs to be implemented.

F. RECOMMENDATIONS AND FOLLOW-UP ACTIONS

The recommendations and follow-up actions are: continue with the remedial design process to reach wellfield design; construct and operate the cleanup system; and monitor the system to determine if cleanup goals are achieved.

G. PROTECTIVENESS STATEMENT

The remedy for the CS-20 plume is expected to be protective of human health and the environment upon completion, and in the interim; exposure pathways that could result in unacceptable risks are being controlled by engineering and institutional controls. Furthermore, AFCEE has determined that there is not an immediate danger, which would require time-critical response for the CS-20 plume.

H. REFERENCES

AFCEE, 2000. *Final Record of Decision for the CS-4, CS-20, CS-21, and FS-13 Plumes.* Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA. February 2000

AFCEE, 1999c. *Final Southwest Operable Unit Proposed Plan for the Southwest Operable Unit* Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA. June, 1999

AFCEE, 1999b. *Final Southwest Operable Unit Feasibility Study for the Southwest Operable Unit* Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA. June, 1999

AFCEE, 1999a. *Final Southwest Operable Unit Remedial Investigation for the Southwest Operable Unit* Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA. May, 1999

USEPA, 2001. *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007, June, 2001.

9.3.13 CHEMICAL SPILL NO.21 (CS-21) GROUND WATER

A. BACKGROUND

A.1 Site Description

The CS-21 Plume is a plume of TCE-contaminated groundwater and was first detected as low concentrations of TCE (below the MCL) in residential well samples collected north of Route 151 in 1997. The plume was further defined in the SWOU RI (AFCEE, 1999a) and was found to be detached from its source area, the location of which is unknown. The plume does not currently discharge to surface water and there are no current exposure pathways to humans as a result of the implementation of institutional controls.

A.2 Initial Responses

AFCEE funded the town of Falmouth to extend public water supply lines and hook-up homes in neighborhoods potentially impacted by CS-21.

A.3 Basis for Taking Action

The CS-21 plume is located within the SWOU, which also includes the CS-4 plume, CS-20 plume, FS-13 plume, FS-28 plume, and FS-29 plume **(**See **Figure 9.13.13-1)**. Based on site characterization activities conducted for the SWOU RI (AFCEE, 1999a), the CS-21 plume was approximately 1,500 feet wide and 7,500 feet long, and had a maximum thickness of 200 feet. The plume underlies 40 to 170 feet of clean water. TCE has been identified as a COC, with concentrations as high as 73.5 µg/l. The calculated risk based on future residential exposure using maximum concentration was greater than the MADEP acceptable risk of $1.0x10^{-5}$.

B. REMEDIAL ACTIONS

This section presents the regulatory actions, remedial action objectives (RAOs), and remedy description for the CS-21 Plume.

B.1 Regulatory Actions

The Final Record of Decision for the CS-4, CS-20, CS-21, and FS-13 plumes (AFCEE, 2000) is the controlling document for the CS-21 plume. The selected remedy for the CS-21 plume includes design, construction, and operation of an extraction, treatment, reinjection (ETR) system to hydraulically capture and treat contaminants; long-term monitoring of the plume; performance monitoring and evaluation of the treatment system; ecological sampling to monitor the impacts of the system to the environment; and institutional controls to protect residents from exposure to SWOU groundwater contaminants. The remedy (Alternative 11) was selected from the analysis of 11 alternatives presented in the SWOU Feasibility Study (AFCEE, 1999b). The Proposed Plan presenting the preferred alternative was released to the public for comment in June 1999.

B.2 Remedial Action Objectives

Remedial Action Objectives to protect human health as presented in the ROD (AFCEE, 2000) are:

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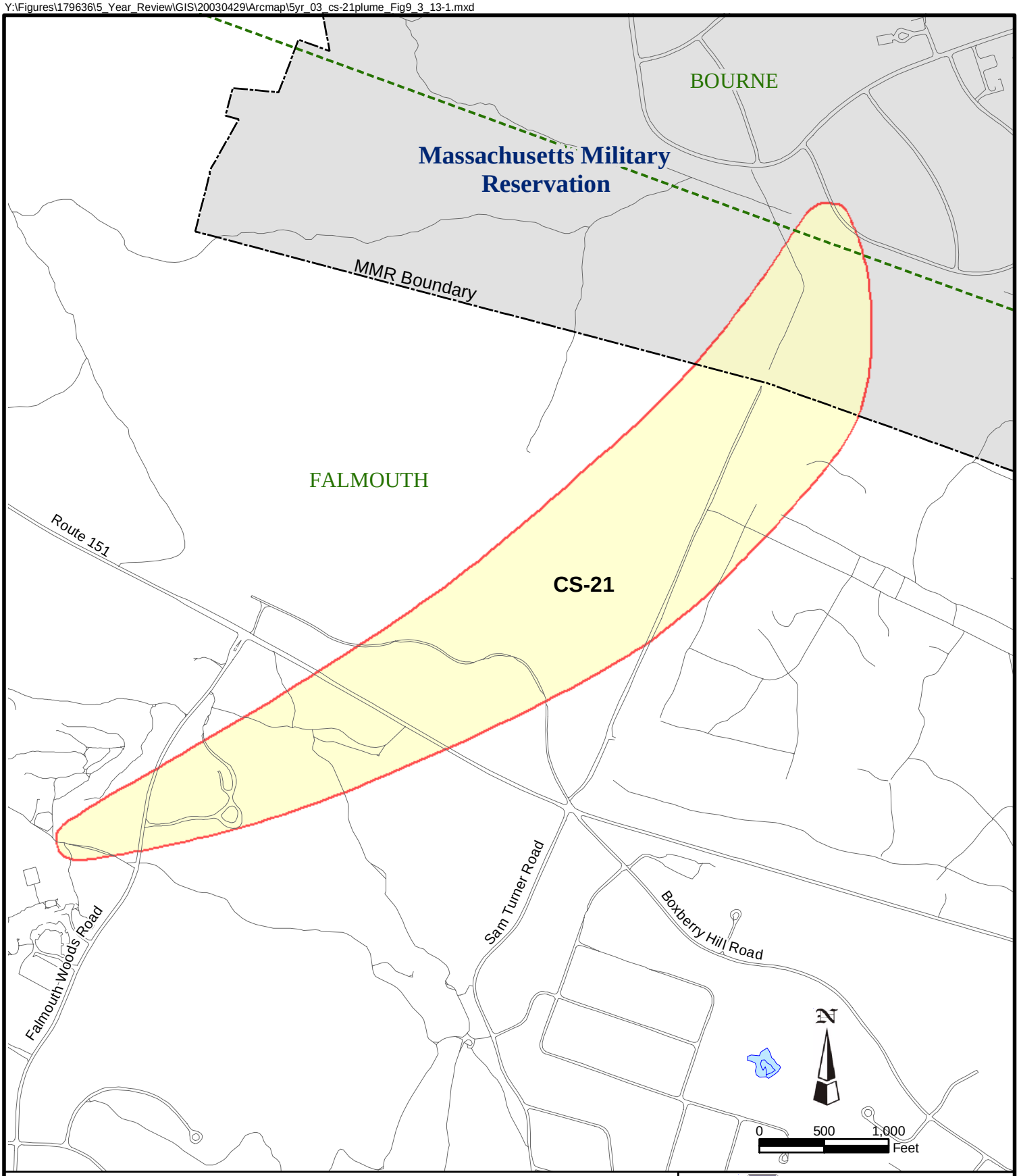

Legend

Plume Contour = Concentrations exceeding drinking water standards or Maximum Contaminant Level (MCL). Represents an exceedance of trichloroethene (TCE) (TCE MCL = 5 µg/L)

Town Boundary

Air Force Center for Environmental Excellence

Chemical Spill 21 (CS- 21) Plume
December 2002

Massachusetts Military Reservation
Cape Cod, Massachusetts

Figure 9.3.13-1

- Prevent or reduce residential exposure to TCE exceeding 5 μg/L in groundwater.
- Restore the aquifer (within confines of the CS-21 plume) to its beneficial uses within a reasonable timeframe.

B.3 Remedy Description

For all of the SWOU plumes, institutional controls have been implemented to protect off-post and on-post residents. For Falmouth residents, a permit is required from the Falmouth Board of Health prior to installation of a well for drinking water; if the permit is granted, water must be tested for VOCs and EDB prior to use. If the Falmouth Board of Health grants a permit for installation of a well that is located above a plume, AFCEE will regularly sample the well. Furthermore, AFCEE will sample drinking wells installed prior to the promulgation of the Falmouth Board of Health regulations that are located above the plume, within 500 feet crossgradient of the plume, or 1,500 feet downgradient of a plume for which public water connections are not provided. On-post residents and workers receive their water from the base water supply system.

The ETR system was modeled using five extraction wells for a combined flow rate of 1,200 gpm. In addition, a separate well processing 200 gpm would be constructed for specifically addressing the leading edge of the plume. The extracted water would be processed through greensand filters and two pairs of GAC units in series. The modeling estimated that the pumping scenario would be capable of capturing 99 percent of the plume after 19 years. The treated water would be discharged through infiltration galleries and/or reinjection wells.

B.4 Remedy Implementation

At this time, the institutional controls component of the selected remedy has been implemented. With regard to the groundwater cleanup systems, AFCEE has completed the fieldwork of a design investigation. The wellfield design for CS-21 will be developed by Summer 2003.

C. PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

The following activities were conducted/observed since the last review.

- Final RI completed in May 1999 (AFCEE, 1999a)
- Final FS completed in June 1999 (AFCEE, 1999b)
- Final ROD completed in February, 2000 (AFCEE 2000)

D. TECHNICAL ASSESSMENT

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on USEPA guidance provided in section 4.0 of the Comprehensive Five-Year Review Guidance (USEPA 2001). **Table D-1** summarizes the answers to the technical assessment questions.

Question A: Is the remedy functioning as intended by the decision documents?

Yes, the remedy design specifications will be constructed in accordance with requirements of the ROD and optimized based on pre-design information. Furthermore, institutional controls are in place to mitigate exposure to humans from contaminated groundwater.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered

There have been no changes in standards or TBC guidance.

Changes in Exposure Pathways

There have been no changes to exposure pathways and land use of the site that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics

There have been no changes in the toxicity factors for COCs.

Changes in Risk Assessment Methods:

There were no changes in risk assessment methodology.

Expected Progress Towards Meeting RAOS:

The remedy is currently in the design phase. The implementation of remedy is expected to restore the aquifer to beneficial purposes. Institutional and engineering controls have achieved the RAO of preventing exposure to humans from chlorinated VOCs in groundwater.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

There is no information that calls into question the protectiveness of the remedy.

Technical Assessment Summary:

A	Is the removal action functioning as intended by the decision documents?	Yes
B	Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the removal action selection are still valid?	Yes
C	Has information come to light that calls into question the protectiveness of the remedy?	No

E. ISSUES

The issue at CS-21 groundwater is: the groundwater extraction and treatment component of the selected remedy needs to be implemented.

F. RECOMMENDATIONS AND FOLLOW-UP ACTIONS

The recommendations and follow-up actions are: continue with the remedial design process to reach wellfield design; construct and operate the cleanup system; and monitor the system to determine if cleanup goals are achieved.

G. PROTECTIVENESS STATEMENT

The remedy for the CS-21 plume is expected to be protective of human health and the environment upon completion, and in the interim; exposure pathways that could result in unacceptable risks are being controlled by engineering and institutional controls. Furthermore, AFCEE has determined that there is not an immediate danger, which would require time-critical response for the CS-21 plume.

H. REFERENCES

AFCEE, 2000. *Final Record of Decision for the CS-4, CS-20, CS-21, and FS-13 Plumes.* Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA. February 2000

AFCEE, 1999c. *Final Southwest Operable Unit Proposed Plan for the Southwest Operable Unit* Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA. June, 1999

AFCEE, 1999b. *Final Southwest Operable Unit Feasibility Study for the Southwest Operable Unit* Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA. June, 1999

AFCEE, 1999a. *Final Southwest Operable Unit Remedial Investigation for the Southwest Operable Unit* Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA. May, 1999

USEPA, 2001. *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007, June, 2001.

9.3.14 CHEMICAL SPILL NO.22 (CS-22) SOURCE

A. BACKGROUND

A.1 Site Description

Area of Contamination (AOC) CS-22 is approximately 17.25 acres located near the east-central portion of MMR **(Figure 11)**. The site consists of a former sand and gravel borrow pit located west of Greenway Road and south of Dolan Road near the MMR access gate (Sandwich Gate) at the northeastern end of Snake Pond Road in Sandwich, Massachusetts.

A.2 Initial Response

During the spring of 2000, the Camp Edwards Environmental Protection Office supervised the removal of approximately 418 tons of soil from the petroleum contaminated soil area in the northern portion of AOC CS-22. There were several detections above the MCP Method 1 S-1/GW-1 standards. The maximum total petroleum hydrocarbons (TPH) concentration detected was 12,000 mg/kg. The soil excavation was initiated by the Camp Edwards Facility Engineering Department on 08 March 2000 and was completed by Clean Harbors Environmental Services, Inc. (under the supervision of the Camp Edwards Environmental Protection Office) on 17 July 2000. Soil removed from the site was stockpiled at a fenced and locked compound in the 3500 block of Camp Edwards prior to removal from the installation. The stockpile was subsequently transported by truck to American Reclamation Corp., a MADEP-licensed soil recycling facility in Charlton, Massachusetts.

A.3 Basis for Taking Action

CS-22 was investigated in 1999 and 2001. Described below is a summary of the site risks and alternatives analyzed for cleanup at CS-22.

1999 Preliminary Assessment (PA): A PA was completed for the CS-22 site in 1999 (AFCEE 2000). The PA identified an area of petroleum-contaminated soil near the northwest end of the gravel pit and 11 small debris areas, most of which are concentrated near the southeast end of the gravel pit. The debris areas contained miscellaneous refuse consisting primarily of construction/demolition debris, asphalt and household waste. Prior to the PA, previous site work consisted of the collection and analysis of two soil samples from the northern portion of the petroleum-contaminated soil area in March 1999.

2001 Site Investigation (SI): The objectives of the CS-22 SI were to provide confirmatory sampling of the petroleum-contaminated soil excavation; determine if waste materials associated with debris areas elsewhere in the gravel pit had contributed to soil contamination; determine if groundwater beneath the site is captured by the existing Chemical Spill-10 (CS-10) extraction, treatment and reinjection systems; determine if a potential risk to human health or ecological receptors exists; and determine appropriate follow-on actions (AFCEE 2001a). The soil analytical results were compared against Massachusetts Contingency Plan (MCP) Method 1 S-1/GW-1 soil standards and USEPA Region IX Residential Preliminary Remediation Goals. Both of these standards are considered extremely conservative and provide a “worst case” scenario for potential risk. Based on the results of the SI, representatives from the USEPA, MADEP and AFCEE agreed in March 2001, that AFCEE should proceed with an Engineering Evaluation/Cost Analysis (EE/CA)

to address soil contaminated with petroleum hydrocarbons and PAHs at AOC CS-22. It was also agreed that no further groundwater investigation was required.

Risk Evaluation Summary: A human-health Preliminary Risk Assessment (PRA) was completed to evaluate potential human-health risks associated with exposure to contaminated surface and subsurface soil under current and future site conditions, and an ecological PRA was completed to evaluate potential ecological risks associated with exposure to contaminated surface soil (zero to 2 feet bgs). Results of the PRA triggered the need for an evaluation of remedial alternatives (i.e. EE/CA. The contaminants of concern (COCs) identified at AOC CS-22 are aluminum, arsenic, barium, chromium, lead, selenium, vanadium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, C11-C22 aromatic hydrocarbons, C19-C36 aliphatic hydrocarbons, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene.

CS-22 Pre-EE/CA Soil Sampling Letter Report: Additional sampling was performed to further delineate petroleum contamination and PAH contamination at AOC CS-22 in 2001. For the purposes of this effort, AOC CS-22 was divided into a northern portion and a southern portion. The scope of work for the northern portion of the site included the collection of 12 surface soil samples from six locations around the perimeter of the southern end of the previous excavation completed in 2000. Samples were analyzed for extractable petroleum hydrocarbons (EPH) using MADEP methodology. No concentrations of EPH were detected above respective MCP Method 1 S-1/GW-1 standards. The scope of work for the southern portion of the site included the collection of 83 soil samples from 41 locations. These samples were analyzed for total carcinogenic PAHs using an on-site immunoassay field screening method. Thirteen of the 83 soil samples that were field-screened were also submitted for laboratory analysis of individual PAH compounds. Four of the soil samples contained levels of individual PAH compounds in excess of applicable MCP Method 1 S-1/GW-1 soil standards (AFCEE, 2001b).

Engineering Evaluation/Cost Analysis (EE/CA): An EE/CA was completed for AOC CS-22 in March 2002 (AFCEE, 2002a). The following three alternatives received detailed analysis in the EE/CA:

- Alternative 1: No Action
- Alternative 2: Institutional Controls and Soil and Groundwater Modeling
- Alternative 3: Excavation, Off-site Disposal and Site Restoration

B. REMEDIAL/REMOVAL ACTIONS

This section presents the regulatory actions, removal action objectives (RAOs), a description of the selected remedy, and a summary of the remedy implementation at AOC CS-22.

B.1 Regulatory Actions

Action Memorandum: The CS-22 Action Memorandum (AFCEE, 2002b) documented the decision to perform removal actions at AOC CS-22. Based on the evaluation of removal action alternatives presented in the EE/CA, the selected alternative was Alternative 3 which included excavating soil contaminated with COCs above removal action levels, and staging the soil for off-site transportation to an appropriately licensed landfill for disposal.

B.2 Removal Action Objectives (RAOs)

The RAOs are site specific qualitative cleanup goals that must be achieved to meet remedial response objectives. Based on this comparison, the following RAOs were established for AOC CS-22:

- Protect ecological and human receptors at AOC CS-22 by mitigating direct exposure to surface soil contaminated with metals and PAHs which may pose unacceptable risk, and
- Mitigate potential impact to groundwater by petroleum hydrocarbons.

B.3 Removal Action Description

The selected removal alternative consists of: excavating an estimated 1,200 cubic yards of soil contaminated with COCs above the RALs; segregation based on whether or not the soil is RCRA hazardous; and staging the soil for off-site transportation to an appropriately licensed disposal facility. Components for this alternative include: design and engineering elements and considerations including preparing a remedial action work plan and a confirmatory sampling program, site preparation, clearing vegetation, excavation of contaminated soil, RCRA waste characterization of excavated soil, off-site disposal, and finally site restoration.

It is important to note that the remedy called for excavated contaminated soil to be transported to an on-base central bulking facility for waste characterization. Excavated soil that is found to have contaminant concentrations in exceedance of TCLP allowable concentrations would be deemed hazardous and disposed of off-site in a RCRA Subtitle C TSDF. Soil that is found to have contaminant concentrations below TCLP allowable concentrations (and that have contaminant concentrations below MADEP MCP Method 1 S-1/GW-1 standards for pesticides and Massachusetts Permitted Soil Recycling Facility Summary Levels) would be deemed nonhazardous and transported offsite to a Subtitle D facility.

B.4 Removal Action Implementation

AFCEE conducted removal activities in 2002 at AOC CS-22. Remedial activities and results of confirmatory sampling will be documented in a Removal Action Report which is anticipated in 2003. Approximately 1,115 cubic yards of contaminated soil were removed from the AOC. Confirmatory sampling results indicated that the contaminant concentrations in soil were below the RALs. Excavated soil was transported to a central bulking facility located on the MMR. Soil from AOC CS-22 was combined with soil from other sites. Composite sampling of the consolidated soil stockpiles determined that the consolidated soil were considered non-hazardous and suitable for reuse as daily cover at a Resource Conservation and Recovery Act (RCRA) Subtitle D Landfill. Soil from the AOC was disposed of at the North Carver Landfill in North Carver Massachusetts. Disposal activities were performed in compliance with the MADEP *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy #COMM-97-001* (MADEP, 1997).

C. PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

The following activities were conducted since the last review.

- EE/CA: Completed October 2001
- Action Memorandum: Completed in January 2002
- Removal Action: Completed in October 2002

D. TECHNICAL ASSESSMENT

The technical assessment component of the five-year review consists of evaluating the protectiveness of the removal action. AFCEE performed the technical assessment based on USEPA guidance provided in section 4.0 of the Comprehensive Five-Year Review Guidance (USEPA, 2001).

Question A: Is the remedy/removal action functioning as intended by the decision documents?

The review of documents, ARARs, risk assumptions, and the results of the site inspection indicate that the removal action has been completed as intended by the EE/CA and Action Memorandum. The excavation and offsite disposal of contaminated soil has achieved the RAOs of mitigating the migration of contaminants to groundwater and preventing direct contact with, or ingestion of contaminants in soil.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered

The removal work has been completed, and ARARs and TBC guidance for soil contamination cited in the EE/CA and Action Memorandum have been met. There have been no changes in chemical-specific ARARs and TBC guidance.

Changes in Exposure Pathways

There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the remedy/removal action.

Changes in Toxicity and Other Contaminant Characteristics

There have been no changes in the toxicity factors for contaminants of concern that were used for the human health and ecological risk evaluations.

Changes in Risk Assessment Methods:

There were no changes in risk assessment methodology.

Expected Progress Towards Meeting RAOs:

Implementation of the remedy is expected to achieve RAOs.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy/removal action?

There is no information that calls into question of the protectiveness of the selected remedy.

Technical Assessment Summary

The remedy was completed as intended by the EE/CA and Action Memorandum. There have been no changes in the physical conditions and land use of the site that would affect the protectiveness of the remedy. ARARs and TBC guidance for soil contamination cited in the EE/CA and Action Memorandum have been achieved. There is no information that calls into question of the protectiveness of the selected remedy.

Table D-1 presents the technical assessment summary for AOC CS-22.

A	Is the removal action functioning as intended by the decision documents?	Yes
B	Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the removal action selection are still valid?	Yes
C	Has information come to light that calls into question the protectiveness of the removal action?	No

E. ISSUES

The issue at CS-22 is that a removal action report documenting the cleanup actions has not been completed.

F. RECOMMENDATIONS AND FOLLOW-UP ACTIONS

The recommendation and follow-up action is to prepare and issue a removal action report after receiving regulatory approval.

G. PROTECTIVENESS STATEMENT

The remedy for AOC CS-22 is protective of human health and the environment. Exposure pathways that could result in unacceptable risks are being controlled. Soil with concentration of contaminants above RALs have been removed.

H. REFERENCES

AFCEE, 2002b. *Chemical Spill No. 22 (CS-22) Action Memorandum (AM)*. Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program; Otis ANGB, MA; May 2002.

AFCEE, 2002a. *Chemical Spill No. 22 (CS-22) Engineering Evaluation/Cost Analysis (EE/CA)*. Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program; Otis ANGB, MA; March 2002.

AFCEE, 2001b. *Chemical Spill-22 Pre EE/CA Soil Sampling Letter Report.* Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR, Installation Restoration Program, Otis ANGB, MA; October 2001.

AFCEE, 2001a. *Final Chemical Spill-22 Site Investigation*, Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR, Installation Restoration Program, Otis ANGB, MA; October 2001.

AFCEE, 2000. *Final Preliminary Assessments for Chemical Spill-8 Coast Guard and Chemical Spill-22.* Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR, Installation Restoration Program, Otis ANGB, MA; March 2000.

MADEP, 1997. *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy # COMM-97-001*, Massachusetts Department of Environmental Protection, 1997.

USEPA, 2001. *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007, June 2001.

9.3.15 COAL YARD-4 (CY-4)/STORM DRAIN-3 (SD-3)/FIRE TRAINING AREA-3 (FTA-3) SOURCE

A. BACKGROUND

A.1 Site Description

Area of Contamination (AOC) SD-3/FTA-3/CY-4 is located near the southeastern border of MMR in a moderately industrialized area on the eastern side of the runways, covering approximately 30 acres. The majority of the AOC is bordered by Granville Avenue on the west and the ANG Ammunition Storage Area on the east (**Figure 11**). A small portion of SD-3 is located east of the ammunition storage area. The SD-3 stormwater drainage ditch receives runoff from this area and the eastern edge of the aircraft maintenance ramp, the former Central Heating Plant, and associated stockpiles of coal and surficial coal ash. Fire training activities reportedly occurred at FTA-3 between 1956 and 1958 following closure of FTA-2 in 1956 (E.C. Jordan Co., 1986). FTA-3 was located in an area where construction debris and coal ash were disposed of after construction of the Central Heating Plant in 1955.

CY-4 is located south of and parallel to Granville Avenue, approximately 400 feet south of the Central Heating Plant location. Coal was stockpiled directly on the ground at CY-4 from 1955 to 1978 and subsequently on a concrete pad. Coal ash was disposed of on the ground surface south of the coal stockpile. Surficial drainage from the coal-stockpile and ash-disposal areas is directed to the SD-3 drainage ditch. The Task 6 records search report indicated that relatively low concentrations of halogenated and non-halogenated solvents, fuel-related compounds, and coal-related compounds (e.g., PAHs and metals) might be present at AOC (E.C. Jordan Co., 1986).

A.2 Initial Response

Between February and April of 1994, the NGB, with concurrence of USEPA and MADEP, excavated coal, coal ash, and potentially contaminated soil from CY-4 and FTA-3 for use as subgrade fill during final capping of the main base landfill (LF-1). A total of 42,000 cy of material, representing the majority of coal and coal ash at CY-4, was excavated to depths of up to 15 feet bgs. Additionally, soil at the FTA-3 location, was also removed. This excavation was then backfilled with clean fill and covered with wood chips, restoring the land surface to approximately original grade. The excavation focused on the coal-stockpile and coal-ash disposal areas and did not encompass the entire surficial area identified during the Remedial Investigation (RI) program.

A.3 Basis for Taking Action

Field Investigations and Mashpee Groundwater Investigation: CY-4/SD-3/FTA-3 site has been investigated several times beginning with a records search in 1986. As part of the Mashpee groundwater study, a multilevel monitoring well cluster was installed downgradient of AOC SD-3/FTA-3/CY-4. These monitoring wells were sampled six times between May 1987 and February 1988. Results indicated that the AOC should be evaluated as a possible source of groundwater contamination (E.C. Jordan Co., 1990).

The SI program, conducted in the fall of 1987, included a storm drain inspection, a soil gas survey, excavation of 14 test pits, installation of seven soil borings with 21 soil samples, collection of one sediment sample, installation of five monitoring wells, collection of one surface water sample,

andgroundwater sampling. The SI also evaluated analytical data from six groundwater sampling rounds completed for the Mashpee groundwater study. Laboratory analyses of sediment and soil samples, storm drain effluent, and groundwater were for TCL VOCs, SVOCs, pesticides, PCBs (soil and sediment only), and TAL inorganics (E.C. Jordan Co., 1989).

RI and Supplemental RI: In 1989, a RI was performed to characterize the nature and extent of sediment, soil, and groundwater contamination at the AOC. Activities included six shallow test pits; two surface coal-ash samples; four storm drain sediment samples; one upgradient monitoring well; four sediment samples with analyses for TCL VOCs, SVOCs, pesticides, PCBs, TAL inorganics, and TPH; 12 groundwater samples with analyses for TCL VOCs, lead, and TPH; and a leaching well liquid sample.

A limited supplemental RI was completed in 1993 to address concerns that additional VOC contamination may exist in the SD-3 drainage ditch and at the outfalls of two storm sewers south of the coal storage yard, which had not been previously sampled. The program consisted of collection of three sediment samples. One was collected from the SD-3 drainage ditch and analyzed for VOCs. The other two were collected from the discharge areas of the southern storm sewers and analyzed for TCL VOCs, SVOCs, pesticides, PCBs, and TAL inorganics (AFCEE, 1996).

Risk Evaluation Summary: The RI report for AOC SD-3/FTA-3/CY-4 included a human-health Preliminary Risk Assessment (PRA) to evaluate potential human-health risks associated with exposure to contaminated surface soil and sediments under current and future site conditions and an ecological PRA to evaluate potential ecological risks associated with exposure to contaminated surface soil and sediment (zero to two feet bgs.). The results of the PRA triggered the need for an evaluation of remedial alternatives (i.e. Feasibility Study). The contaminants of concern (COCs) identified at AOC SD-3/FTA-3/CY-4 are phenanthrene, chrysene, arsenic, chromium, lead, vanadium, and zinc.

Feasibility Study: AOC SD-3/FTA-3/CY-4 was included as part of the Six Areas of Contamination Source Area Feasibility Study completed in November 1997 (AFCEE, 1997a). The Feasibility Study assessed how well the following two alternatives would meet the evaluation criteria while controlling migration of contaminants from deep soil to groundwater at the AOC:

- Alternative 1: No action
- Alternative 2: Confirmation Sampling with Contingency of Excavation/Asphalt Batching

B. REMEDIAL/REMOVAL ACTIONS

This section presents the regulatory actions, removal action objectives (RAOs), a description of the selected remedy, and a summary of the remedy implementation at AOC SD-3/FTA-3/CY-4.

B.1 Regulatory Actions

Described below are the controlling documents that present the selected remedy and post-record of decision (ROD) documents that identified changes to the selected remedy.

ROD: The *Record of Decision for Areas of Contamination FTA-2/LF-2, PFSA/FS-10/FS-11, SD-2/FS-6/FS-8, SD-3/FTA-3/CY-4, and SD-5/FS-5 Source Areas* finalized in September 1998 (AFCEE, 1998) was prepared to document the decision to perform removal actions a several AOCs including

SD-3/FTA-3/CY-4. The selected remedial alternative for the SD-3/FTA-3/CY-4 source area was Alternative 2, Confirmation Sampling with Contingency of Excavation/Asphalt Batching. This alternative provides institutional and engineering controls to limit exposure to site-related contaminants and to reduce source-area contaminant concentrations to protective levels. The *Proposed Plan to Cleanup Six Areas of Contamination* (AFCEE, 1997b) was issued in November 1997 for public comment. All comments received at the public hearing and during the public comment period are included in Appendix C of the ROD.

Explanation of Significant Differences (ESD): The *Explanation of Significant Differences for Areas of Contamination CS-10 (A, B & E); CS-16/CS-17; FS-9; SD-2/FS-6/FS-8; SD-3/FTA-3/CY-4* finalized in January 2003 (AFCEE, 2003) was prepared to document changes to the selected remedy for several sites in the Source Area Remedial Action Program (SARAP) including SD-3/FTA-3/CY-4. Three changes are made to the selected remedy presented in 6 AOC ROD: (1) establishment of RALs for certain inorganic chemicals and PCBs; (2) removal of the asphalt-batching component from the selected remedy; and (3) the expansion of offsite disposal options to include RCRA Subtitle D facilities.

B.2 Removal Action Objectives (RAOs)

The RAOs are site specific qualitative cleanup goals that must be achieved to meet remedial response objectives. Because response objectives were not identified for AOC SD-3/FTA-3/CY-4, remedial action objectives were not developed. The Feasibility Action stipulated that soil sampling should be performed to confirm the adequacy of previous removal actions.

The PRA completed at the AOC SD-3/FTA-3/CY-4 identified potential risks to receptors for the following COCs: phenanthrene, chrysene, arsenic, chromium, lead, vanadium, and zinc. MMR-specific Soil Target Cleanup Levels (STCLs) used for the DSRP were retained and used to develop cleanup levels for identified contaminants of concern. In 2000, AFCEE with concurrence from USEPA and MADEP revised ecological risk based STCLs for inorganic chemicals in a Technical Memorandum (AFCEE, 2000).

In 2002, AFCEE revised phytotoxicity and invertebrate STCLs for several inorganics in an addendum to the Technical Memorandum (Portage, 2002). The revised STCLs led to the development of RALs, which also took into account terrestrial plant screening levels, terrestrial invertebrate screening levels, and MMR-specific background levels. COCs and respective cleanup levels are presented in **Table B-1.**

Phenanthrene	Ecological Risk	.0625
Chrysene	Ecological Risk	.0625
Arsenic	Background	7.1
Chromium	Background	19
Lead	Ecological Risk	99
Vanadium	Ecological Risk	47
Zinc	Ecological Risk	68

B.3 Remedy Description

The selected remedy documented in the ROD is Confirmation Sampling with Contingency of Excavation/Asphalt Batching. This alternative provides institutional and engineering controls to limit exposure to site-related contaminants and to reduce source-area contaminant concentrations to protective levels. Confirmatory sampling after excavation would ensure that all soil with COC concentrations exceeding these cleanup levels was removed. Excavated soil that is found to have contaminant concentrations in exceedance of TCLP allowable concentrations would be deemed hazardous and disposed of off-site in a RCRA Subtitle C TSDF. Soil that is found to have contaminant concentrations below TCLP allowable concentrations (and that have contaminant concentrations below MADE MCP Method 1 S-1/GW-1 standards for pesticides and Massachusetts Permitted Soil Recycling Facility Summary Levels) would be deemed nonhazardous and treated at the on-site cold mix emulsion asphalt-batching plant.

The selected remedy for AOC SD-3/FTA-3/CY-4 was modified. Changes to the selected remedy included deletion of the on-site asphalt batching component of the remedy; establishment of RALs to replace cleanup levels presented in the ROD; and expansion of offsite disposal options to include RCRA Subtitle D facilities. These changes are documented in an ESD for the Source Area Remedial Action Program (SARAP) (AFCEE, 2003).

The modified remedy consisted of excavating contaminated surface soil at the AOC. Excavated soil would be transported to on-base central bulking facility for waste characterization. Excavated soil that is determined to exceed TCLP allowable concentrations and therefore deemed hazardous would be disposed off-site in a RCRA Subtitle C TSDF. Soil that is determined to be below TCLP allowable concentrations and therefore nonhazardous (and that are determined to contain contaminant concentrations below MADEP MCP Method 1 S-1/GW-1 standards for pesticides and Massachusetts Permitted Soil Recycling facility Summary Levels) would be transported offsite to a Subtitle D facility.

B.4 Remedy Implementation

Excavation and Disposal: AFCEE conducted removal activities in 2001 at AOC SD-3/FTA-3/CY-4. Removal activities and results of confirmatory sampling will be documented in a Remedial Action Report which is anticipated in 2003. Approximately 1,065 cubic yards of contaminated soil were removed from the AOC. Confirmatory sampling results indicated that the contaminant concentrations in soil were below the RALs. Excavated soil was transported to a central bulking facility located on the MMR. Soil from AOC SD-3/FTA-3/CY-4 was combined with soil from other

sites. Composite sampling of the consolidated soil stockpiles determined that the consolidated soil were considered non-hazardous and suitable for reuse as daily cover at a Resource Conservation and Recovery Act (RCRA) Subtitle D Landfill. Soil from the AOC was disposed of at the Taunton Landfill in Massachusetts. Disposal activities were in compliance with the MADEP *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy #COMM-97-001* (MADEP, 1997).

C. PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

The following activities were conducted since the last review.

- Source Areas Remedial Design: Completed September 2000
- Removal Action: Completed in April 2002.
- ESD: Completed in January 2003

D. TECHNICAL ASSESSMENT

The technical assessment component of the five-year review consists of evaluating the protectiveness of the removal action. AFCEE performed the technical assessment based on USEPA guidance provided in section 4.0 of the Comprehensive Five-Year Review Guidance (USEPA, 2001).

Question A: Is the remedy/removal action functioning as intended by the decision documents?

The review of documents, ARARs, risk assumptions, and the results of the site inspection indicate that the removal action has been completed as intended by the ROD and modified by the ESD. The excavation and offsite disposal of contaminated soil has achieved the RAOs of mitigating the migration of contaminants to groundwater and preventing direct contact with, or ingestion of contaminants in soil.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered

The removal work has been completed, and ARARs and TBC guidance for soil contamination cited in the ROD have been met. There have been no changes in chemical-specific ARARs and TBC guidance. AFCEE recalculated risk-based STCLs for ecological receptors to reflect current toxicity information. RALs were derived from the comparison of the following: revised STCLs, background, phytotoxicity screening levels, and invertebrate screening levels. The new cleanup levels remain protective of human health and the environment. Cleanup levels identified in the ROD were derived from the comparison of cleanup levels used in the DSRP and background. These cleanup levels initially did not take into account invertebrate or phytotoxicity screening levels; however, they were taken into account in the ESD. **Table D-1** presents changes in cleanup levels at AOC SD-3/FTA-3/CY-4.

Chromium	Soil	19	6.8
Lead	Soil	99	15.8
Vanadium	Soil	47	15.2
Zinc	Soil	68	16

Changes in Exposure Pathways

There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the remedy/removal action.

Changes in Toxicity and Other Contaminant Characteristics

There have been no changes in the toxicity factors for contaminants of concern that were used for the human health risk assessment. However, risk-based cleanup levels for ecological receptors were calculated using new toxicity information. Calculation of ecological risk-based STCLs using new toxicity information was completed in 2000 (AFCEE, 2000). These STCLs were used in the development of RALs for which cleanup was based.

Changes in Risk Assessment Methods:

There were no changes in risk assessment methodology.

Expected Progress Towards Meeting RAOs:

Implementation of the remedy is expected to achieve RAOs.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy/removal action?

There is no information that calls into question of the protectiveness of the selected remedy.

Technical Assessment Summary

The remedy was completed as intended by the ROD. There have been no changes in the physical conditions and land use of the site that would affect the protectiveness of the remedy. ARARs and TBC guidance for soil contamination cited in the ROD are being achieved. There is no information that calls into question of the protectiveness of the selected remedy.

Table D-2 presents the technical assessment summary for AOC SD-3/FTA-3/CY-4.

A	Is the removal action functioning as intended by the decision documents?	Yes
B	Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the removal action selection are still valid?	Yes
C	Has information come to light that calls into question the protectiveness of the removal action?	No

E. ISSUES

The issue at SD-3/FTA-3/CY-4 is that a remedial action report documenting the cleanup actions has not been completed.

F. RECOMMENDATIONS AND FOLLOW-UP ACTIONS

The recommendation and follow-up action at SD-3/FTA-3/CY-4 is to prepare for regulatory review and approval the remedial action report.

G. PROTECTIVENESS STATEMENT

The remedy for AOC SD-3/FTA-3/CY-4 is protective of human health and the environment. Soil containing COCs above RALs have been removed.

H. REFERENCES

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9.3.16 DRUM DISPOSAL OPERABLE UNIT (DDOU) SOURCE

A. BACKGROUND

A.1 Site Description

Area of Contamination (AOC) DDOU is approximately 0.25 acres, and is located in the southeast corner of the Cantonment Area near the corners of Simpkins Road and Sandwich Road (**Figure 11)**.

The DDOU consists of a clearing in a wooded area located southeast of the former MMR sewage treatment plant at AOC CS-16/CS-17. A former sanitary sewer sludge disposal area is located southwest of the DDOU. The ground slope in the area of the DDOU is nearly level with no severe slopes. A trench feature also was observed at the DDOU that contained black sludge-like material (ASI, 1997).

A.2 Initial Response

The DDOU was discovered during RI activities at AOCs CS-16/CS-17 in 1994. A total of 11 drums were observed in the area on the ground surface. Four of the eleven drums contained various volumes of liquid. These four drums were placed in over-pack drums and removed from the site. The remaining seven drums were wrapped in plastic sheeting and also removed. All eleven drums were stored in Building 120, located on MMR. The liquid in the four drums was sampled by NGB personnel and analyzed for VOCs, pesticides, polychlorinated biphenyls, and total petroleum hydrocarbons. All of the compounds analyzed for were below the detection limits. Upon receipt of these results, NGB personnel disposed of the drums.

Based on the presence of the drums, two surface-soil samples were collected and analyzed as part of the AOC CS-16/CS-17 RI. Results of sample analysis indicated that two surface samples contained pesticides and other analytes. The pesticides, particularly 4,4'-DDT, 4,4'-DDD, 4,4'-DDE, and alpha-BHC, were found at concentrations over 100 mg/kg.

A.3 Basis for Taking Action

Site Investigation (SI): A SI was completed in December 1994 and was intended to determine the nature and vertical and horizontal extent of contamination at DDOU (ASI, 1997). The field investigations conducted included: the completion of 24 shallow soil Geoprobe® borings and collection of soil samples for immunoassay DDT kit analysis and confirmatory laboratory analysis, completion of 4 deep soil borings as monitoring wells and collection of soil samples for Contract Laboratory Program (CLP) analysis, the collection of ten surface soil samples for CLP analyses, and groundwater sampling for CLP analyses.

The SI report identified two areas of soil contamination that contained pesticides above MMR-specific STCLs; one area measuring approximately 60 by 40 feet (Area 1) encompassing drums numbered one through seven, and the other approximately 20 by 50 beet (Area 2) encompassing drums numbered nine through eleven. SVOC and inorganic analytes at concentrations above STCLs were found commingled in the two areas of pesticide contamination. Data from Area 1 indicated 4,4'-DDT concentrations in surface soil as high as 36,000 mg/kg. Additionally, SVOCs and several inorganic analytes, including arsenic, chromium, lead, vanadium, and zinc, were found at concentrations exceeding respective STCLs within area one. At Area 2, concentrations of 4,4'-DDT

were reported as high as 4.1 mg/kg. The highest concentrations of 4,4'-DDE and 4,4'-DDD detected in Area 2 were less than 0.1 mg/kg.

None of the four monitoring wells sampled as part of the DDOU investigation contained detectable concentrations of pesticides.

Risk Evaluation Summary: Based on results of the 1994 site evaluation, a soil removal action was recommended to address residual pesticides that were commingled with SVOCs and inorganic analytes. At AOC DDOU contaminant concentrations were compared to hazard equivalent concentrations (HECs). Concentrations exceeding these risk-based values indicated the need for a removal action at the AOC. A PRE was not conducted for this study area, however the following COCs were accepted by AFCEE for the DDOU study area as part of the SARAP: 2-chlorophenol, 1,2,4-trichlorobenzene, 2,4-dinitrotoluene, pentachlorophenol, Phenanthrene, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-BHC, Arsenic, Chromium, Lead, Vanadium, and Zinc.

Engineering Evaluation/Cost Analysis (EE/CA): The DDOU was included as part of the Priority 2 and 3 Study Areas and DDOU EE/CA completed in October 1998 (AFCEE, 1998).

The following alternatives received detailed analysis in the EE/CA:

- Alternative 1: On-Base Thermal Desorption and Off-base Treatment and Disposal for DDOU
- Alternative 2: On-Base Asphalt batching and Off-Base Treatment and Disposal for the DDOU
- Alternative 3: Off-base Treatment and /or Disposal for the DDOU.

B. REMEDIAL/REMOVAL ACTIONS

This section presents the regulatory actions, removal action objectives (RAOs), a description of the selected removal action, and a summary of the removal action implementation at the DDOU.

B.1 Regulatory Actions

Described below are the controlling documents that present the selected removal action and post-EE/CA documents that identified changes to the selected removal action.

Action Memorandum (AM): An AM for the Priority 2 and 3 Study Areas and DDOU Source Removal (AFCEE, 1999) documented the decision to perform removal actions at several Priority 2 and 3 study areas including the DDOU. Based on the evaluation of removal action alternatives presented in the EE/CA, the selected alternative was Alternative 2 which included excavating DDOU soil and treating the excavated material on-base using an asphalt batching facility and/or off-base at an approved treatment and disposal facility.

Action Memorandum Addendum: AM Addendum for Priority 2 and 3 Study Areas and DDOU Source Removal (AFCEE, 2003) was prepared to document changes to the selected removal action for several sites encompassed by the AM. The selected removal action for the DDOU was changed with the establishment of new removal action levels (RALs) for certain inorganic chemicals.

B.2 Removal Action Objectives (RAOs)

The RAOs are site-specific qualitative cleanup goals that must be achieved to meet remedial response objectives. Investigations conducted at the DDOU demonstrate that surface soil contaminated with multiple PAHs, pesticides and inorganics may pose unacceptable risk to humans and ecological receptors. RAOs were developed based on these considerations, and were established to achieve the overall objective of protecting human health and the environment. The objectives address human-health and ecological risks, as well at the potential groundwater impact posed by contaminated soil.

MMR-specific Soil Target Cleanup Levels (STCLs) used for the DSRP (AFCEE, 1996) were retained and used to develop cleanup level concentrations for identified COCs. In 2000, AFCEE with concurrence from USEPA and MADEP revised ecological risk based STCLs for inorganic chemicals in a Technical Memorandum (AFCEE, 2000). In 2002, AFCEE revised phytotoxicity and invertebrate STCLs for several inorganics in an addendum to the STCL Technical Memorandum (AFCEE, 2002).

The revised STCLs led to the development of RALs, which also took into account terrestrial plant screening levels, terrestrial invertebrate screening levels, and MMR-specific background levels. Development and establishment of RALs were documented in the AM Addendum finalized in 2003 (AFCEE, 2003). Presented in **Table B-1** are RALs that must be achieved to meet remedial response objectives for the DDOU.

INORGANICS		
Arsenic	Ecological	7.1
Chromium	Background	19
Lead	Ecological	99
Vanadium	Ecological	47
Zinc	Ecological	68
PAHs		
2-chlorophenol	Ecological	300
1,2,4-trichlorobenzene	Human	9,250
2,4-dinitrotoluene	Ecological	330
Pentachlorophenol	Ecological	800
Phenanthrene	Ecological	625
PESTICIDES		
4,4'-DDD	Ecological	2.41
4,4'-DDE	Ecological	0.227
4,4'-DDT	Ecological	0.250
alpha-BHC	Ecological	0.203

B.3 Removal Action Description

The selected removal action documented in the AM (AFCEE, 1999) consisted of excavating contaminated soil and treating this material on-base using an asphalt batching facility and/or off-base at an approved treatment and disposal facility. Excavated soil that is found to have contaminant

concentrations in exceedance of TCLP allowable concentrations would be deemed hazardous and disposed of off-site in a RCRA Subtitle C TSDF. Soil that is found to have contaminant concentrations below TCLP allowable concentrations (and that have contaminant concentrations below MADEP MCP Method 1 S-1/GW-1 standards for pesticides and Massachusetts Permitted Soil Recycling Facility Summary Levels) would be deemed nonhazardous and be treated at the on-site cold mix emulsion asphalt batching plant. Post excavation confirmatory sampling was conducted to ensure that all soil with COC concentrations exceeding DDOU soil cleanup levels were removed.

The selected removal action for DDOU was modified. Changes to the selected removal action included: establishment of RALs to replace cleanup levels presented in the AM; and expansion of offsite disposal options to include RCRA Subtitle D facilities. These changes are documented in AM Addendum for Priority 2 and 3 Study Areas and Drum Disposal Operable Unit Source Removal (AFCEE, 2003) for the SARAP.

The modified removal action consisted of excavating contaminated surface soil at DDOU. Delineation and confirmatory sampling results indicated that the excavated soil was RCRA hazardous. The excavated soil was disposed off-site in a RCRA Subtitle C TSDF.

B.4 Removal Action Implementation

AFCEE conducted removal activities in 2001 at the DDOU. Approximately 213 cubic yards of contaminated soil was excavated from DDOU. Delineation and confirmatory sampling results indicated that the soil was hazardous, therefore requiring disposal at a RCRA Subtitle C TSDF. The contaminated soil was excavated, loaded directly into trucks, and transported to Ross Incineration Services located in Grafton, Ohio.

C. PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

The following activities were conducted since the last review.

- Priority 2 and 3 Study Areas and DDOU AM: Completed in June 1999
- Removal Action: Completed in August 2001
- Priority 2 and 3 Study Areas and DDOU AM Addendum: Completed in February 2003

D. TECHNICAL ASSESSMENT

The technical assessment component of the five-year review consists of evaluating the protectiveness of the removal action. AFCEE performed the technical assessment based on USEPA guidance provided in section 4.0 of the Comprehensive Five-Year Review Guidance (USEPA, 2001).

Question A: Is the remedy/removal action functioning as intended by the decision documents?

The review of documents, ARARs, risk assumptions, and the results of the site inspection indicate that the removal action has been completed as intended by the AM and modified by the AM Addendum. The excavation and offsite disposal of contaminated soil has achieved the RAOs of mitigating the migration of contaminants to groundwater and preventing direct contact with, or ingestion of contaminants in soil.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered

The removal work has been completed, and ARARs and TBC guidance for soil contamination cited in the AM and AM Addendum have been met. There have been no changes in chemical-specific ARARs and TBC guidance. AFCEE recalculated risk-based STCLs for ecological receptors to reflect current toxicity information. RALs were derived from the comparison of the following: revised STCLs, background levels, phytotoxicity screening levels, and invertebrate screening levels. The new cleanup levels which were identified as RALs remain protective of human health and the environment. Cleanup levels identified in the AM were derived from the comparison of cleanup levels used in the DSRP and background. These cleanup levels initially did not take into account invertebrate or phytotoxicity screening levels; however, they were taken into account in the AM Addendum. **Table D-1** presents changes in cleanup levels at DDOU.

Arsenic	Soil	3.6	7.1
Chromium	Soil	6.8	19
Lead	Soil	15.8	99
Vanadium	Soil	15.2	47
Zinc	Soil	16	68

Changes in Exposure Pathways

There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the removal action.

Changes in Toxicity and Other Contaminant Characteristics

There have been no changes in the toxicity factors for contaminants of concern that were used for the human health risk assessment. However, risk-based cleanup levels for ecological receptors were calculated using new toxicity information. Calculation of ecological risk-based STCLs using new toxicity information was completed in 2000 (AFCEE, 2000). These STCLs were used in the development of RALs. Cleanup was based on these RALs.

Changes in Risk Assessment Methods:

There were no changes in human health risk assessment methodology.

Expected Progress Towards Meeting RAOS:

Implementation of the removal action has achieved RAOs.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy/removal action?

There is no information that calls into question of the protectiveness of the selected removal action.

Technical Assessment Summary

Table D-2 presents the technical assessment summary for the DDOU.

A	Is the removal action functioning as intended by the decision documents?	Yes
B	Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the removal action selection are still valid?	Yes
C	Has information come to light that calls into question the protectiveness of the removal action?	No

E. ISSUES

The issue at DDOU is that a removal action report documenting the cleanup actions has not been completed.

F. RECOMMENDATIONS AND FOLLOW-UP ACTIONS

The recommendation and follow-up action is to prepare and issue a removal action report after receiving regulatory approval.

G. PROTECTIVENESS STATEMENT

The removal action for AOC DDOU (source control including excavation and off-site disposal) is protective of human health and the environment. Soil containing COCs above RALs has been removed, and DDOU has achieved unlimited use and unrestricted exposure.

H. REFERENCES

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AFCEE, 1999. *Action Memorandum Priority 2 and 3 Study Areas and Drum Disposal Operable Unit Source Removal*. Prepared by Harding Lawson Associates (HLA) for AFCEE/MMR Installation Restoration Program; June 1999.

AFCEE, 1998. *Priority 2 and 3 Study Areas Drum Disposal Operable Unit Engineering Evaluation/Cost Analysis.* Prepared by HLA for AFCEE/MMR Installation Restoration Program; October 1998.

AFCEE, 1996. *Soil Target Cleanup Levels, DSRP*. Prepared by HAZWRAP for AFCEE/MMR Installation Restoration Program; January 1996.

USEPA, 2001. *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007, June 2001.

9.3.17 EASTERN BRIARWOOD (GROUND WATER)

A. BACKGROUND

A.1 Site Description

The Eastern Briarwood plume was a result of migration of contaminants from industrial and military activities in the southeastern portion of the MMR. Potential sources of contamination in the Eastern Briarwood area may have included, FS-25, CS-14, Central Heating Plant, Weapons Storage Area, and USCG/FS-1. The Eastern Briarwood plume was part of the SERGOU, which also included the Western Aquafarm plume and the SD-5 plume.

A.2 Initial Responses

There have been no initial responses.

A.3 Basis for Taking Action

The basis for conducting monitoring is the site characterization and risk assessment results of the RI. The SERGOU RI was completed in 1994. One subset of the SERGOU was called southeast MMR groundwater, which was later, identified as the Eastern Briarwood area (ANG 1994). The SERGOU RI concluded that the source area for the Eastern Briarwood area was the industrial area located within the southeastern portion of MMR. Concentrations detected ranged from 0.3 to 15 µg/L for TCE and from 0.2 to 14 µg/L for PCE. Low concentrations of chlorinated solvents were detected at various depths and locations; however, a plume boundary was not delineated. It was determined that the contamination was related to occasional spills from normal operations and not from a sustained source due to the low concentrations and lack of a pattern. The power plant and the weapons storage area were identified as potential sources of these small releases. The report also indicated that shallow contaminated groundwater in this area would discharge into Johns Pond and the Quashnet River (ANG 1994). Estimated current and future cancer risks associated with residential use of groundwater were above the MADEP allowable risk of $1x10^{-5}$. Please note that the Eastern Briarwood area is one of the seven groundwater plumes included in the Interim Record of Decision (IROD) (ANG, 1995), and is currently undergoing the IROD to Final ROD process. As part of the IROD to ROD process, COCs will be identified for the final ROD. **Table A-1** presents interim action COCs and respective cleanup levels.

PCE	Human Health	5	Fed MCL
TCE	Human Health	5	Fed MCL

B. REMEDIAL ACTIONS

This section presents the regulatory actions, RAOs, and remedy description for the Eastern Briarwood Plume.

B.1 Regulatory Actions

The National Guard Bureau (NGB) implemented several phases of the Superfund process to address contamination affecting the sole-source aquifer. The plume boundaries were defined through extensive groundwater investigations. Through a public process, it was determined that there was sufficient data to design systems that would stop the seven groundwater plumes (i.e., Ashumet Valley, CS-10, Eastern Briarwood, FS-12, LF-1, SD-5, and Western Aquafarm) from moving closer to residential areas and water bodies.

In an attempt to accelerate the process, the Plume Response Plan was developed in 1994 to contain the seven groundwater plumes. The Plume Management Process Action Team helped coordinate development of this plan. The Plume Response Plan was used as a substitute for the Feasibility Study and as a basis to develop the Proposed Plan. The NGB, Department of Defense (DoD), EPA, MADEP, and local communities approved the plan, resulting in an accelerated effort toward "simultaneous containment" of the seven-groundwater plumes.

In 1995, the NGB and EPA, with MADEP concurrence, signed an Interim Record of Decision (IROD) (ANG, 1995) for the seven groundwater plumes. The IROD enabled the NGB to take immediate action to protect human health and the environment, while collecting additional information to evaluate and select final cleanup alternatives.

The conceptual model for the interim response action for the Eastern Briarwood plume included eight extraction wells and 16 injection wells. The eight extraction wells were to be placed in a line perpendicular to the migration of the plume, and the injection wells would be located 50 feet down gradient. The exact location was dependent on further investigation, but placement on the MMR boundary was preferred. The total design flow rate was between 240 and 300 gpm. This remedy was proposed to contain the Eastern Briarwood plume at the leading edge.

After the TRET evaluated the 60-percent design submittal, it was determined that this remedy could not be implemented without a detrimental impact to the sensitive ecosystems, undesirable alterations in regional groundwater flow paths, and counterproductive spreading of the contamination. The TRET made several recommendations in their review, and recommended that the Eastern Briarwood plume be monitored instead of building a groundwater extraction system. Regulatory agencies agreed with the recommendation.

The revised approach for Eastern Briarwood presented in the *Strategic Plan* (AFCEE 1997) was long-term monitoring to ensure that no unacceptable toxicological risks develop from discharge to the Quashnet River.

B.2 Remedial Action Objectives

The objectives defined in the IROD (ANG, 1995) were used as the basis for determining cleanup goals.

The objectives in the IROD are described as follows:

- reduce the risks to human health associated with the potential future consumption and direct contact with groundwater and surface waters;
- protect uncontaminated groundwater and surface waters for future use by minimizing the migration of contaminants;

- reduce potential ecological risks to surface waters and through the implementation of the containment system; and,
- restore the aquifer to its beneficial uses with a 20 year timeframe.

B.3 Remedy Description

AFCEE established a comprehensive long-term monitoring program to evaluate changes in groundwater contaminant concentrations in Eastern Briarwood and conducted additional field investigations to refine the understanding of contamination in Eastern Briarwood groundwater and Quashnet River surface water and to ensure that no unacceptable toxicological risks develop.

B.4 Remedy Implementation

In 1996, a long-term monitoring (LTM) program for the Eastern Briarwood area was initiated to assess contaminant trends and distributions. The LTM program for Eastern Briarwood is currently ongoing and is in its sixth year of performance. The program initially included quarterly sampling of monitoring wells in the area and was later expanded to include surface water sampling of the Quashnet River and drilling programs to more effectively monitor contamination and to further delineate more recent EDB detections in the area. The Eastern Briarwood plume outline was revised during the fourth year of the monitoring program when TCE concentrations decreased below the MCL at upgradient monitoring locations and the western boundary monitoring well. In the fifth year of the monitoring program, TCE concentrations at monitoring well 00MW0569 decreased below the MCL, eliminating the Eastern Briarwood plume. The reduction of the Eastern Briarwood plume over the past five years of this monitoring program was attributed to natural attenuation processes, including adsorption, diffusion, dispersion, and dilution, occurring within the plume.

Historically, EDB was not a COC in the Eastern Briarwood area, but it was detected at concentrations that exceeded the MMCL (0.02 μg/l) in two monitoring wells installed during the 1998 drilling program (00MW0573B and 00MW0576B) and in monitoring wells 00MW0577A and 00MW0579B, installed during the 2000 drilling program. EDB was not detected in any of the other monthly sampling events conducted during 2000 and 2001.

In 2000 and 2001, the USGS conducted additional investigations to further delineate the EDB detected in Eastern Briarwood during the LTM program. A diffusion sampling survey was completed in the Quashnet River and bog system in December 2000. EDB was detected in samples collected from the K4 bog, which was attributed to EDB contamination in Eastern Briarwood (AFCEE 2001b). No EDB was detected in upgradient locations. A second diffusion sampling survey was completed in Moody Pond and no EDB was detected. Four multilevel monitoring wells were installed along the Quashnet River east of existing monitoring well cluster 00MW0573 and EDB concentrations detected were consistent with previous results.

C. PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

AFCEE is conducting semiannual groundwater and surface water sampling at the Eastern Briarwood Area.

D. TECHNICAL ASSESSMENT

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on USEPA guidance provided in section 4.0 of the Comprehensive Five-Year Review Guidance (USEPA 2001). **Table D-1** summarizes the Technical Assessment.

Question A: Is the remedy functioning as intended by the decision documents?

Yes, the remedy is functioning as intended by the IROD as modified by the Strategic Plan, which documents the TRET recommendation of long-term monitoring. No COCs (i.e., PCE, TCE, and EDB) have been detected in the latest sampling round conducted in June 2002 (AFCEE, 2002b). AFCEE is currently completing the IROD to ROD process, which may alter the interim remedy based on results of current groundwater monitoring data as well as conclusions of the human health risk assessment.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered

There have been no changes in standards or TBC guidance.

Changes in Exposure Pathways

There have been no changes to exposure pathways and land use of the site that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics

There have been no changes in the toxicity factors for COCs.

Changes in Risk Assessment Methods:

There were no changes in risk assessment methodology.

Expected Progress Towards Meeting RAOS:

The remedy is making progress towards meeting RAOs. PCE and TCE were not detected above MCLs and EDB was not detected above the MMCL in the most recent groundwater monitoring report (AFCEE, 2002b).

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

No.

A	Is the removal action functioning as intended by the	Yes

	decision documents?	
B	Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the removal action selection are still valid?	Yes
C	Has information come to light that calls into question the protectiveness of the remedy?	No

E. ISSUES

The issue for Eastern Briarwood groundwater is that a final remedy is required.

F. RECOMMENDATIONS AND FOLLOW-UP ACTIONS

The recommendation and follow-up action is a final remedy should be selected and documented in a final ROD. This process is underway with the issuance of the IROD to ROD workplan of which Eastern Briarwood is a part.

G. PROTECTIVENESS STATEMENT

The remedy is currently protective of human health and the environment. Current monitoring data indicate that the natural attenuation of COCs has achieved groundwater cleanup goals.

H. REFERENCES

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